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U.S. SUBS in action

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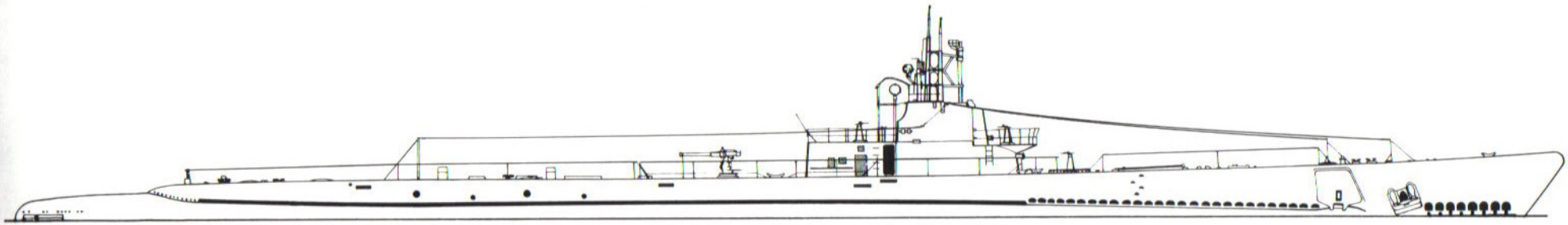
WARSHIPS NO.2

U.S. SUBS
in action

by Robert C. Stern

illustrated by Don Greer



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(Cover) Harder, under CO Sam Dealey, surfaces near the sinking Japanese destroyer, *Ikazuchi*, 14 April 1945. The destroyer had been preparing to depth charge Harder when she was hit by Harder's torpedoes. Her armed depth charges are exploding as she goes down - Harder is painted in a very early Measure 32/3SS-B, the "light gray job". Her periscope tops have been painted pink on the theory that pink took on the hue of surrounding colors.

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Abbreviations

CO - Commanding Officer, known as 'Skipper' or 'Captain'
XO or Exec - Executive Officer, second in command
ASW - Anti-Submarine Warfare
GRT - Gross Register Tons
BuOrd - Bureau of Ordnance
Mk - Mark
ComSubPac - Commander of Submarines, Pacific Fleet
AA - Anti-Aircraft

Acknowledgements

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The Submarine Force Library and Museum Assoc. Inc.
Groton, CT 06340

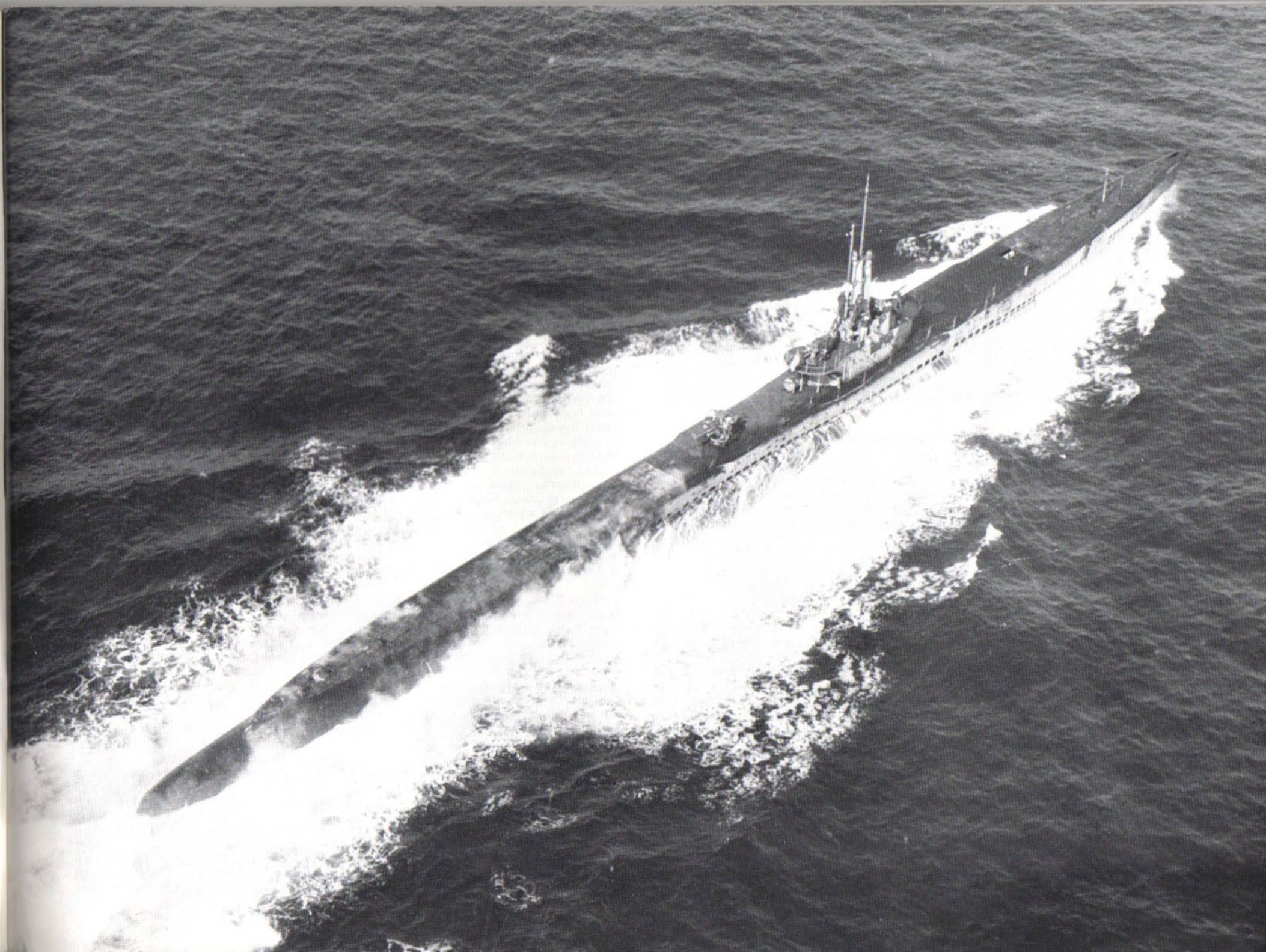
and: The Combined Great Lakes Navy Assoc. Inc.
P.O. Box A-3785
Chicago, IL 60690

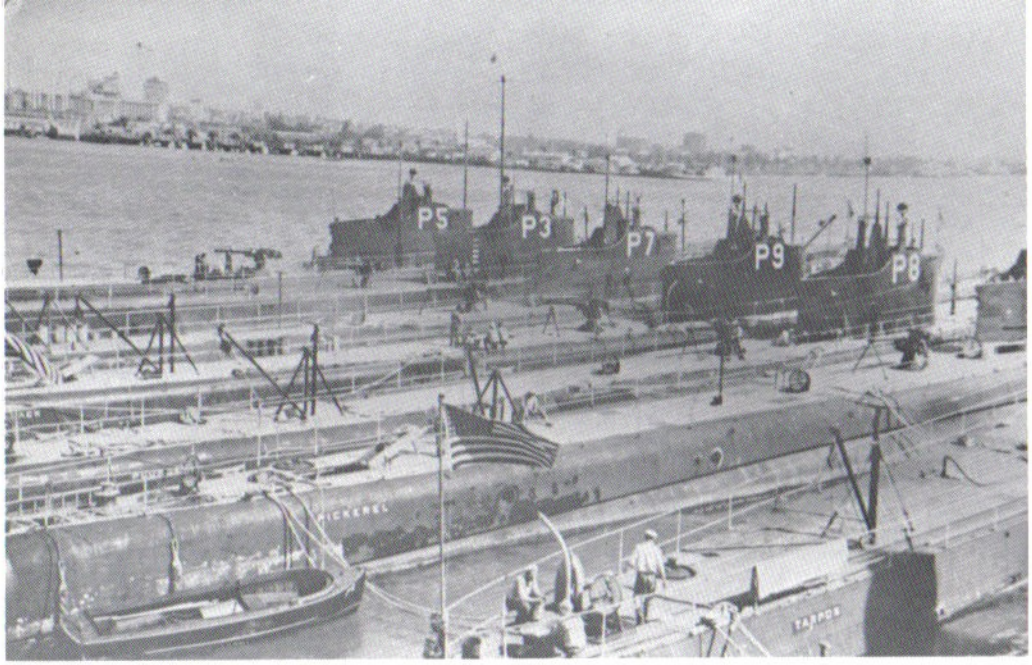
The former is actively involved in collecting and preserving as much of the history of US submarines as they can lay their hands on. The latter is restoring **Silversides**, which is in nearly 1945 configuration, to her former grandeur. Both are non-profit organizations, worthy of assistance, and contributions are tax deductible.

A Note on the Drawings

The drawings included in the section on each class show the boats at launch and once during the war with the exception of **Dolphin** and the **Gatos**. These should be taken as only representative of the class as a whole, though they are as accurate as possible for the boat and time named. The originality shown by the refit crews at Mare Island and elsewhere was positively amazing. I believe that it's safe to state that by 1945 no two US subs looked exactly alike.

At high speed, leaving a tremendous wake, Redfish is seen off Pearl Harbor in 1945. On her second patrol, she sank the Japanese aircraft carrier *Unryu*, 19 December 1944. (National Archives)





A line-up of P class boats, probably at the Submarine Base, New London, Conn. is seen during the '30s. They are back to front, P5-Perch, P3-Shark, P7-Permit, P9-Pollack, P8-Plunger, P6-Pickerel and P4-Tarpon. At this time submarine duty was hardly glamorous, the boats themselves being known as 'pigboats'. This nickname originated with the old Holland boats which had no periscope and therefore had to surface and submerge constantly to maintain contact with their target. Surface fleet sailors ungraciously compared this to the movement of porpoises, or 'sea pigs', hence 'pigboats'. (Dave Merriman)

Introduction: The Submarine War

The war in the Pacific during World War II, to this day, raises heroic images of Marines storming the seawall at Tarawa or Dauntlesses pushing over against the Japanese carriers at Midway. Few would state that American submarines were decisive in that effort. Yet not only were the submarines a decisive element, the argument can be made that they were **the** decisive element. Simply stated, Japan, as an overpopulated island nation, went to war when its imports of vital resources were threatened. She made war with the aim of assuring the continued flow of those imports and lost the war when the ships carrying those imports were rotting on the ocean floor. Postwar analysis revealed that it was impending starvation that brought Japan to her knees, with the atomic bomb providing impetus. Contrary to popular belief the island-hopping campaigns of MacArthur and Nimitz and the firebombing of Japan's cities didn't critically affect her will or ability to resist.

If the loss of the shipping war doomed Japan, it was the American sub that won the war. Of the nearly 10 million tons of Japanese naval and merchant shipping lost during the war, US submarines accounted for over 54%. Yet the Submarine Force never comprised more than 1.6% of naval personnel. Had persistent technical and tactical problems not dogged the Submarine Force through most of the war, that score might well have been higher. Under any circumstances, this remarkable performance deserves the recognition it has long been denied.

The US had been, at one point, in the forefront of submarine development. Bushnell's **Turtle** and the Confederate **H.L. Hunley** had been the first offensive underwater craft. The Holland and Lake designs of 1899 and 1905 were among the first practical submersibles. The US Navy had been the second, after France, to commission military submarines. By 1917 that situation had sadly changed. The US had lagged far behind the warring European powers, particularly in diesel and torpedo development. The L class, which was the newest class in service at the time of the US entry into World War I, was smaller, slower and less well armed than its European contemporaries. By the end of the war, the disparity was even greater as both Germany and Great Britain had launched several classes of "ocean-going" submarines to which the US had no reply.

The end of the war brought new challenges to the United States. With the threat of Imperial Germany eliminated and the Royal Navy in firm control of the Atlantic, the US Navy turned its attention to the Pacific. Navy planners had been keeping a wary eye on Japanese capabilities and intentions since their sudden and unexpected victory in the Russo-Japanese War. The US and Japan had been friendly since Japan was 'opened' by Admiral Perry in 1853. Still, the seeds of future friction were very much present at the end of World War I. Not only were the Japanese replacing Western Imperialism in China, with whom the US was even more friendly, with their own brand, but they also showed every intention of retaining the German Pacific territories in the Marianas, Carolines and Marshalls which they had 'liberated' during the war. Should hostilities ever break out, these island positions could threaten communications between the continental United States and its own Pacific possessions: Wake, Guam and the Philippines. Further, the Japanese themselves appeared to see the potential for naval conflict in the Pacific. Their "8-8 Plan" of 1916 was seen by the US Navy as a direct threat to its domination of that ocean.

World War I had 'proven' the submarine as a weapon. Certainly in the US Navy it had not been seriously considered as an offensive weapon before the war. The German U boat campaign altered that thinking. No naval staff could plan a future conflict without including the submarine as a scouting and anti-shipping weapon. The US plan for war with Japan, Plan Orange, was now modified to include submarines to screen for the fleet as it advanced toward the anticipated climactic battle in the Philippine Sea, to snipe at enemy units advancing from Japan and to assist the fleet once battle was joined. This called for a boat with very considerable improvements over anything then in service or planned for the US Navy. This new boat had to be able to cruise the Pacific and also keep up with the fleet at an average 21 knots. The plans called for a 'fleet-type' boat.

The S and T classes then under construction were not adequate. The S boats, at 854 tons with a range of 5000 miles were simply too small. The T class boats were big enough at 1100 tons, but were a miserable failure as a design. They were underpowered, underarmed and unhandy in relation to other nations' designs and were soon withdrawn from front-line service. US Navy planners turned to the successful German U-Kreuzer designs for guidance. The U 139 class represented the best approach to date to the problem of designing an effective, long-range submersible weapon. The U-Kreuzer carried only slightly more armament than a conventionally-sized submarine, but used its greater size to carry that armament to much greater distances. With a surface displacement of 1930 tons, U 139 could carry six torpedo tubes and two 6" deck guns to a range of almost 13,000 miles. This was a performance that exceeded that of any boat the US had considered and fitted the Navy's needs almost exactly.

Fortunately for the US Navy, U 140 of the U 139 class was acquired as reparations in 1919. For two years, U 140 was intensively tested, by which time the construction of America's reply, the V class, was under way. The first V boats, the **Barracudas** which were launched in 1924, were an improvement over the Ts though they still left a great deal to be desired. Over the next 17 years the US Navy would experiment with five more classes before a wholly satisfactory boat was found. There was considerable struggle during these pre-war years over the role submarines were to play which in turn had an effect on the evolving submarine designs. Submarine Force lobbied for an independent role for its boats, the surface fleet wanted the subs directly tied to fleet

movements. Because of the failure of the V boats to be able to maintain fleet speed, battle fleet admirals reluctantly gave up the idea of subs operating as a scouting screen for the fleet, though they did not give up their insistence that the sub's primary function was aiding the fleet, more important than just sinking ships. This controversy was still raging when the Japanese obligingly provided an answer.

The Tambor class, with which the US went to war, had the very qualities that Navy planners had been seeking in the first V boats. They were fast and had enough range to qualify for the name 'fleet boat'. But they never had the chance to prove or disprove the theory of tying subs to the fleet (although Japanese experience with combined operations was almost entirely negative). The attack on Pearl Harbor broke all the rules. From 7 December 1941 the US Navy had to re-learn how to deploy its fleet boats. No longer tied to a now non-existent battle fleet, suddenly US subs became the primary, and for the time being, only offensive tool available to the Navy. They were sent out with instructions to sink any and all ships.

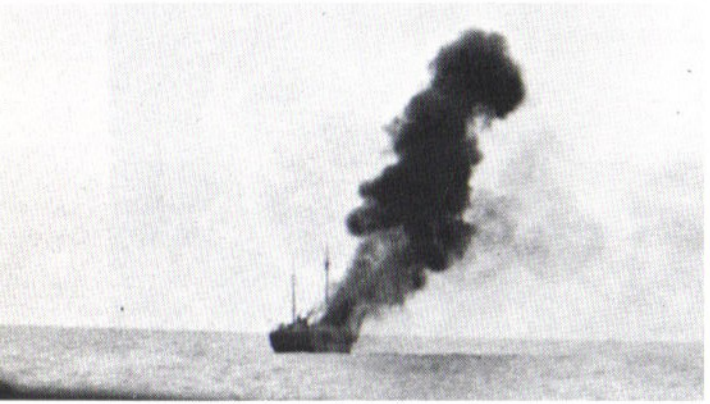
The first contacts with the enemy were cautious and the results were hardly encouraging. The unreality of Fleet Exercises in the '30s, in which subs were given the task of 'attacking' primed and concentrated defenses, led to an exaggerated view of the risks to a sub in taking on the ASW forces of the day. Since being 'sunk' during an exercise was disastrous to a naval career, submarine commanders became a very cautious bunch, preferring to attack from well below periscope depth, at extreme range, by hydrophone information. In reality, such attacks had small chance of success. The boats themselves ranged from excellent to awful. The new Tambors were first-rate in every respect, while the recommissioned S boats and the early Vs would be a challenge just to sail. Further, the boats were scattered and without unified command. And there simply were not enough of them. 23 fleet boats, seven of ten Ps and all 16 Salmons, were transferred to Manila to join six S boats in the defense of the Philippines. More S boats were tabbed to operate from England, later to be joined by new fleet boats. This left the Pacific Fleet Submarine Force at Pearl Harbor, the main offensive arm, with pitifully few boats with which to fight the war. In December 1941 ComSubPac had only V4 through V9, the three remaining Ps and 12 new Tambors, a total of 21 boats, assigned to him. Of these, only 11 were immediately available. The remainder were refitting or working up. A tug of war soon developed between the Pacific Fleet and the Asiatic Fleet based at Manila, and later Australia, over the allocation of the meager available resources. It was midwar before the Pearl Harbor command emerged as the dominant force, and even then the Australian-based boats remained a separate entity until the end of hostilities. The 'command problem' was never completely solved.

When US subs came into first contact with the enemy, all these problems had their effect. The first attacks were all sonar approaches from below 100 ft. and were uniformly unsuccessful. Very few skippers had the initiative to break with prewar doctrine and come up to periscope depth or surface when attacking. As a result, the first patrols of the 11 Pearl Harbor boats resulted in the sinking of exactly four enemy ships.

Another problem cropped up that was to bedevil the Submarine Force throughout the war, namely faulty torpedoes. US subs started the war equipped with the Mk XIV steam driven torpedo fitted with the Mk VI influence exploder. This exploder was a magnetic device designed to explode the torpedo under the keel of the target, making a single torpedo sufficient to sink all but the largest targets. Developed between the wars, the Mk VI was the pride of BuOrd (Bureau of Ordnance) and the object of strictest security. So afraid was the Navy that the Mk VI's secret might be stolen that no one in the fleet was trained in its use, manuals were printed but locked away and no complete tests were made. In 1939-40 both Britain and Germany, who had their own magnetic exploders, found them to be highly unreliable and discontinued their use. BuOrd paid no attention. Yet the very first days of the war saw problems with the Mk VI. The first CO to complain was Tyrell Jacobs of **Sargo**. While on his first patrol off Cam Ranh Bay he fired his first shots of the war which exploded prematurely. Jacobs reasoned that this was not proper behavior, that either the Mk VI was faulty or the Japanese had countermeasures. He proceeded to disconnect the magnetic feature on his remaining torpedoes, leaving the back-up contact exploder, and altered the depth setting to have them hit rather than run under the target. In six further attacks **Sargo** launched 14 torpedoes. None exploded. Jacobs concluded that the Mk XIV was running deep or that the contact exploder was faulty, or both. Upon his return to Java, Manila having been lost, he was severely reprimanded for disconnecting the Mk VI exploder. His request for live tests was turned down. After another zero patrol Jacobs quit in frustration, his career in submarines at an end. Yet events were to cast him as a prophet.

There was one development at this stage that boded extremely well for the future. Spurred on by the success of the British RDF service in tracking German U boats, and feeling not a little guilty over their failure to keep track of Japanese naval units during the critical weeks before Pearl Harbor, the US Navy's radio intelligence unit (known officially as the Research Desk, Office of Naval Communications, particularly the Hypo unit based at Honolulu, responsible for RDF, cryptanalysis, traffic analysis, etc.) came up with the first of many correct predictions as to the location of Japanese warships. The information that Hypo provided was considered accurate enough by ComSubPac that **Gudgeon's** return from her first patrol was delayed. She was instead ordered to a

The crew of Trout, **a Tambor class boat, is seen here unloading rather unusual ballast at Pearl Harbor, February 1942. One of the boats diverted for the resupply of Corregidor,** Trout **delivered a full load of 3517 3" shells. Needing ballast, and there being no sandbags to spare, she took on 20 tons of gold bars and silver coins that had been evacuated from Manila banks. After conducting a full war patrol,** Trout **returned to base and unloaded.**



In a typical gun action, Silversides, under CO Burlingame, takes on a Japanese picket boat off Truk, 14 October 1942. (Above) One of a well known series, this photo shows the crew of the 3"/50cal deck gun and the ammo handlers carrying rounds from the ready storage in the fairwater. (US Navy via SFL). (Left) The target of all this activity, a bit worse for the wear, during its last minutes afloat. (National Archives)

position on the projected course of *I-173* and instructed to wait submerged for the Japanese sub to show. Precisely on schedule, on 27 January 1942, *I-173* sailed across **Gudgeon's** bow and was dispatched. She was the first major Japanese warship to be sunk by any US force, but much more importantly she was the first victim of the 'Ultra' network that was to become increasingly efficient and deadly to enemy shipping as the war progressed.

In the Western Pacific the Japanese were advancing, driving the Allied land and sea forces before them. US surface forces were quickly withdrawn from Manila to Java, leaving only the submarines of the Asiatic Fleet to defend the Philippines. **Sealion** became the first submarine loss of the war when she was caught, while undergoing refit, by the first Japanese air raid on Manila. Hit by two bombs and badly damaged, she was stripped of all salvageable equipment and scuttled. 22 of the remaining 28 Asiatic Fleet subs were immediately deployed to face the expected Japanese invasion. The showing that these boats made was nothing short of terrible. The problems with torpedoes, tactics and command personnel were the same that plagued the Pearl Harbor boats. Torpedoes malfunctioned with depressing regularity. They prematured, failed to explode, or exploded weakly. They ran deep or ran erratically, even occasionally running a circular course. In December 1941 over 70 torpedoes were fired at 28 targets by the 22 active Asiatic Fleet subs. One hit. The ingrained caution of the COs and the confused leadership from Manila meant that many good opportunities were not pressed. Only 'Moon' Chapple, CO of **S38**, and his daring raid into Lingayen Gulf stood as an isolated example of offensive spirit. Not surprisingly **S38** had the one success, a 5000GRT transport, during the period between Pearl Harbor and 26 December when Manila was abandoned. The base for Asiatic Fleet subs retreated through Surabaya to Darwin, Australia.

All in all these initial results were not what the Navy expected or needed. The Submarine Force had been tested and found wanting. Still with the incapacitation of the battle fleet, the submarine provided the only means for striking directly at Japan. The eradication of the obvious problems should have been the highest priority. Instead the necessary changes were agonizingly slow in coming. Each department seemed to think that the problems lay elsewhere, resisting change within its own domain. For example, when Jacobs of **Sargo** complained of torpedo problems, he was informed by BuOrd experts on the spot that the difficulties were caused by his crew's inexperience. They assured him there was no need to alter the torpedoes. A few of the less aggressive skippers were relieved after one or two patrols. The remaining problems were taken under advisement or simply ignored. The three main problems, torpedoes, tactics and command personnel, would continue to hinder the efficiency of the Submarine Force for some time to come. A case can be made for the thesis that Japan was 'defeated' the instant that the first bomb fell on Pearl Harbor. By the numbers, in terms of population and industrial strength, Japan simply could not defeat an America determined to see the war through, and the Pearl Harbor raid guaranteed that determination. From then on the question was not if the US would win, but when. It was not a question of if the submarine would become an effective tool against Japan's lifelines, but when. The tale of submarines sailing alone into the enemy's waters in those dark, early days of the war is only half of the drama. Equally as fascinating is the story of the frustrating struggle against the persistent problems that threatened to prevent US submarines from achieving their incredible potential.

At a time when everything else was going wrong a new personality dumped a new task upon the Asiatic Fleet subs. At Gen. MacArthur's insistence Corregidor was to be resupplied by submarine. It was a task for which submarines were not well suited. Each sub could carry, at best, only a day's supplies for the island and there were not enough boats to send them daily. The results were predictable. Corregidor was not adequately supplied, and part of the already limited number of boats were diverted from offensive missions. Throughout the spring of 1942, Asiatic Fleet subs were shunted back and forth at MacArthur's whim until the island fell in May. By then both MacArthur and the Asiatic Fleet were back at Australia, licking their wounds. The fall of Corregidor meant a temporary end to 'special missions', but with the emergence of the Philippine guerilla movement they reappeared. MacArthur's conception of the Asiatic Fleet as an extension of and support for his land forces was to be a recurring problem.

The battle of Midway, generally accepted as one of the turning points of the Pacific war, was in June 1942. 12 US submarines were deployed around Midway Island, four of these seeing enemy warships. One, **Nautilus**, came to periscope depth in the middle of the Japanese fleet but no damage was inflicted on the enemy. The only submarine success of the battle belonged to *I-168* which sank the damaged *Yorktown* and the destroyer *Hammann*. (No story is more indicative of the impotence felt by the crews of US submarines because of the torpedo problems than that of **Nautilus**. Coming upon the sinking *Kaga*, **Nautilus** fired all four bow tubes. One torpedo failed to leave the tube, two ran too deep, the fourth struck but failed to explode. The air flask from that

torpedo was used as a life preserver by several *Kaga* crewmen.) As had been the case during the defense of the Philippines, the submarine proved itself to be a poor defensive weapon. They had to be deployed in wastefully large numbers to gain anything like adequate coverage, doing a job that aircraft could do more efficiently and inexpensively. In this case, however, the results might have been better had the torpedoes functioned properly.

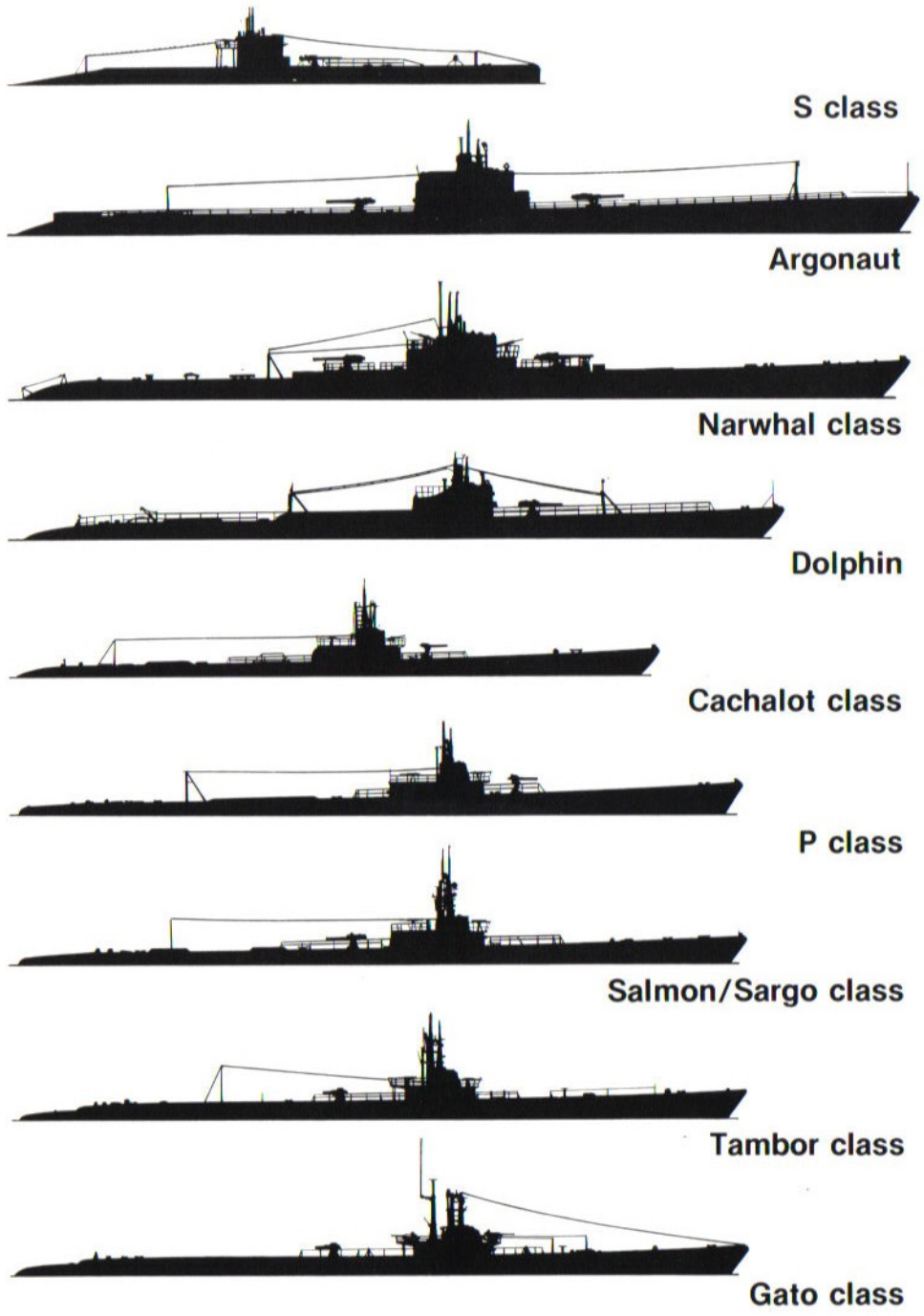
Although the Japanese were repulsed at Midway, their feint in the Aleutians succeeded. Two of the islands, Attu and Kiska, were occupied. The US Navy had been informed by Hypo that the feint was coming and had stationed 10 S class boats at Dutch Harbor to defend the area. The S boats failed to sight, much less stop, the Japanese invasion fleet. In the process they lost one of their number, **S27**, which ran aground in poorly charted waters. Seven fleet boats were immediately transferred to the Aleutians on temporary duty. **Growler**, under CO Howard Gilmore, sank one enemy destroyer and damaged two others. **Triton** sank another. **Grunnion** was lost to particularly heavy Japanese ASW. There were no other sightings, much less successes, for either side. The six remaining fleet boats were sent back to Pearl Harbor. For the S boats that remained what followed was a war in which the Japanese were almost a secondary enemy. The real challenge was surviving the atrocious weather, tricky currents and poor charts in the Aleutians. For the rest of 1942 the Aleutian boats could claim one sinking of 3000GRT, nearly losing one of their own to the weather.

In June 1942 there was another, less obvious turning point. The Asiatic Fleet subs came under the command of an energetic new commander, Rear Adm. Charles Lockwood. Anyone of flag rank in the Navy had obviously held many, varied commands, but Lockwood, as opposed to some others in the Submarine Force, considered himself first and foremost a submariner. He had been **V3**'s first CO and had commanded the first squadron of P class subs, the first true fleet boats, in 1936. He had also fought long and hard in planning sessions to prevent the fleet boat design from being emasculated by surface fleet admirals, and equally long and hard to prevent the independent role of submarines from being subordinated to that of the battle fleet. He had been relatively successful. Now, as commander of most of America's submarines, he set out to show what they could do.

One of Lockwood's first acts was to test the Mk XIV for deep running. Two days of simple tests proved that it did so consistently. Still it would take months for Ordnance to accept the test results, more time for a fix to be found and applied. And there were those who felt that deep running was only part of the problem. As if to confirm this the results of the first patrols made after the fix was applied showed no significant upsurge of sinkings. There were obviously still problems, particularly with the influence exploder. Lockwood also relieved more than a quarter of his skippers and criticized most of the rest for lack of aggressiveness. This did not significantly alter the success rate either.

In the Western Pacific, as at Midway, Japanese submarines seemed to be having greater success. The largest Japanese warship sunk by US subs to date was the heavy cruiser *Kako* sunk by old **S44** off Kavieng on 10 August 1942. In comparison, during a two week period in late August, Japanese subs put one torpedo into *Saratoga*, forcing her back to Pearl Harbor for three months, put another into the battleship *North Carolina* for damage and three more into *Wasp*, sinking her.

In August, the Submarine Force was further split up by the decision to replace the antique S boats that had been operating in the Solomons with fleet boats. The only places to find replacements were at the Asiatic Fleet bases on the west coast of Australia. Lockwood's forces were split up. Seven of his 15 boats were moved to Brisbane, effectively removing them from the main campaign. They suffered, as did those from Lockwood's and the Pearl Harbor commands, from poor tactical positioning. The planners of all three groups failed to realize that enemy shipping of all types was most vulnerable on the high seas. The Japanese used established trade routes which could have been attacked with relative impunity. There existed bottlenecks, most notably the Luzon Strait between Luzon and Formosa, where routes crossed and traffic was often heavy. Instead of being directed to such points, subs were consistently sent



to patrol off harbors where the water was shallow and the ASW concentrated. As an example, between July and September 1942, 11 Pearl Harbor subs were ordered to patrol the major Japanese base at Truk. The results were plenty of sightings but only eight sinkings and each boat was bombed or depth charged at least once. Only one boat recorded a notable success. **Greenling** reported sinking a Japanese aircraft carrier, the first such to be sunk by a US sub. That was half right. The ship **Greenling** sank, the 12,000 GRT OSK liner *Brazil Maru,* the largest ship sunk to that point by a US sub, was scheduled to be converted to an escort carrier upon her return to Japan. (Survivors of *Brazil Maru* reported that the first four of seven torpedoes that **Greenling** fired hit but failed to explode. Obviously problems still remained with the torpedoes.)

Another tactic was tried. In order to relieve pressure on the Solomons, two of the big old boats, **Argonaut** and **Nautilus**, were assigned to transport a Marine raiding party to Makin Island in the Gilberts. The August raid was a success in that 211 men of the 2nd Marine Raider Battalion (Carlson's Raiders) destroyed a seaplane base and wiped out the island's 70 man garrison. It was a failure in the much more important sense that no forces were diverted from the Solomons. (The raid also had the disastrous side effect of bringing the vulnerability of the Gilberts to Japanese attention. When Tarawa and Makin were invaded over a year later, the Japanese were ready.)

The last months of 1942 saw some improvement in the situation of US subs. A number of factors accounted for this change. New Gato class boats were beginning to arrive at Pearl Harbor in significant numbers. Some of the older, clumsier boats were being sent home for training duties and other antiques were being permanently assigned to MacArthur's special missions. Equally important was the gradual replacement of less aggressive skippers with younger, less cautious COs. Just as significant was the crop of young XOs, some not thirty, who were gaining experience, some of whom would begin rising to command within the next, decisive year. The first effective surface-search radar, the SJ, was fitted on a fleet sub in August. While still experimental and full of bugs, it proved an excellent aid to attack and navigation. At first available in limited quantities, within the year all US subs would be SJ equipped. Also positive was the increasing trust being put into 'Ultra' reports, which consistently led to sightings if not always sinkings.

On the debit side of the ledger at the end of the year was the continuing torpedo problem, making the results of any attack, no matter how well executed, a matter of chance. The disastrous splitting of forces and objectives continued unabated. The new commander in the South Pacific, Bill Halsey, ordered the transfer of nine additional boats from Pearl Harbor to Brisbane. Just when the Pacific Fleet squadrons were being replenished, they were again decimated. Saddest of all was the fact that the transfer meant that the newest boats were being redirected from the productive patrols in Empire waters to the far less profitable hunting grounds of the Southwest Pacific. (For reasons that defy explanation to this day, Pearl Harbor subs were getting consistently better results from their torpedoes than were those of either Australian command.) So depleted were the squadrons at Pearl Harbor that ComSubPac was only able to send 10 patrols to the Home Islands during the last two months of the year.

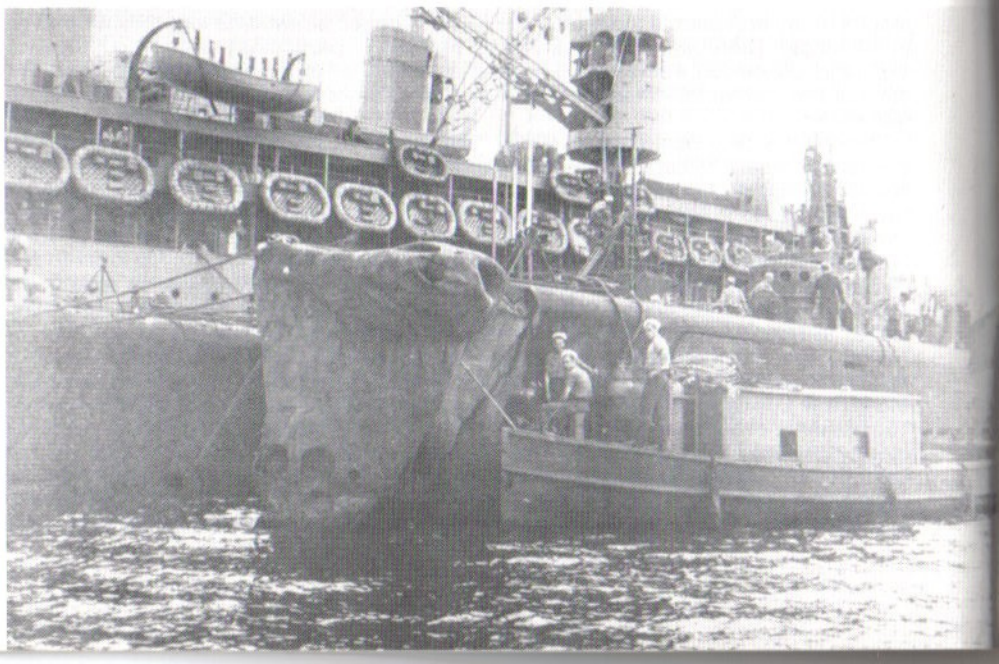
A compilation of statistics on the last six months of fighting would have shown anyone interested that patrols to Empire waters were twice as productive (at an average of just under two sinkings per patrol) than those to Truk or other targets. Long months would pass before anyone in the Submarine Force drew the obvious conclusion. The submarines were simply not being used to best advantage. During 1942, US subs sank 180 Japanese ships for a total of 725,000GRT. During the same 12 months, U boats sank 1160 Allied ships for over 6,000,000GRT.

To start off the new year there was an important change in command personnel. Lockwood, who had been stuck in Western Australia with eight subs to command, was chosen to take over as ComSubPac. A new commander was also assigned to Brisbane, at that time the largest concentration of US subs. The new commander, Jimmy Fife, had his own ideas for improving the poor showing of the boats. He concluded that skippers were being given too much latitude. He instituted a policy of strict control of boat movement and action from headquarters. This resembled and was modeled after the technique used by Donitz to direct his U boats in the Atlantic. But this was to have disastrous results. Fife required that each CO keep him informed of his exact location. Unfortunately the Japanese appear to have been listening in. In all of 1942, the US had lost seven submarines, only three of those to enemy ASW. In the first two months of 1943 Fife lost four, with two more badly damaged. Fife refused to admit that excess radio traffic was compromising his boats, but he quickly discontinued his experiment in long-range control.

One of Fife's damaged boats, **Growler**, created a legend that still lives in the Submarine Force. Attacking what was believed to be an auxiliary gunboat on the night of 7 February 1943, **Growler**, under CO Howard Gilmore, prepared for a surface action. Luck was against Gilmore. The target, actually a small freighter, saw **Growler** and turned to ram. For some reason this change of course was not noted by anyone on **Growler** until it was too late and collision was unavoidable. As soon as the two boats had struck, **Growler's** bridge came under heavy small arms fire. Two crewmen on the bridge were killed immediately and Gilmore badly wounded. The bridge having been cleared except for the wounded Gilmore, **Growler's** exec waited for Gilmore to come down the ladder. He never did. Apparently unable to move, and realizing that every second **Growler** stayed on the surface put her in increasing danger, he gave his famous shout, "Take her down!" After a few seconds of agonizing hesitation, the XO followed his order. Gilmore's posthumous Medal of Honor was the first to a submariner.

In early 1943, with the winding down of the Solomons campaign and the concentration of Navy interest on the future island-hopping campaign in the Central Pacific, one and a half squadrons, seven boats, were transferred back from Brisbane to Pearl Harbor. As two of the eight Fremantle boats had been lost and not replaced in those months, the two Australian bases began to diminish in importance. From this point on the Asiatic Fleet would become less and less important to the overall war effort. One of the boats transferring back to Pearl Harbor was **Wahoo**, destined to become probably the most famous submarine of the war. After two disappointing

Back at Brisbane, docked next to her tender, Growler **has returned from her brush with disaster and glory, February 1943. On her fourth patrol, CO Howard Gilmore ordered** Growler **to dive as he lay wounded on her bridge as a result of a collision and ensuing firefight with a Japanese freighter. For his self-sacrifice Gilmore won the first Congressional Medal of Honor given to a submariner. (SFL)**

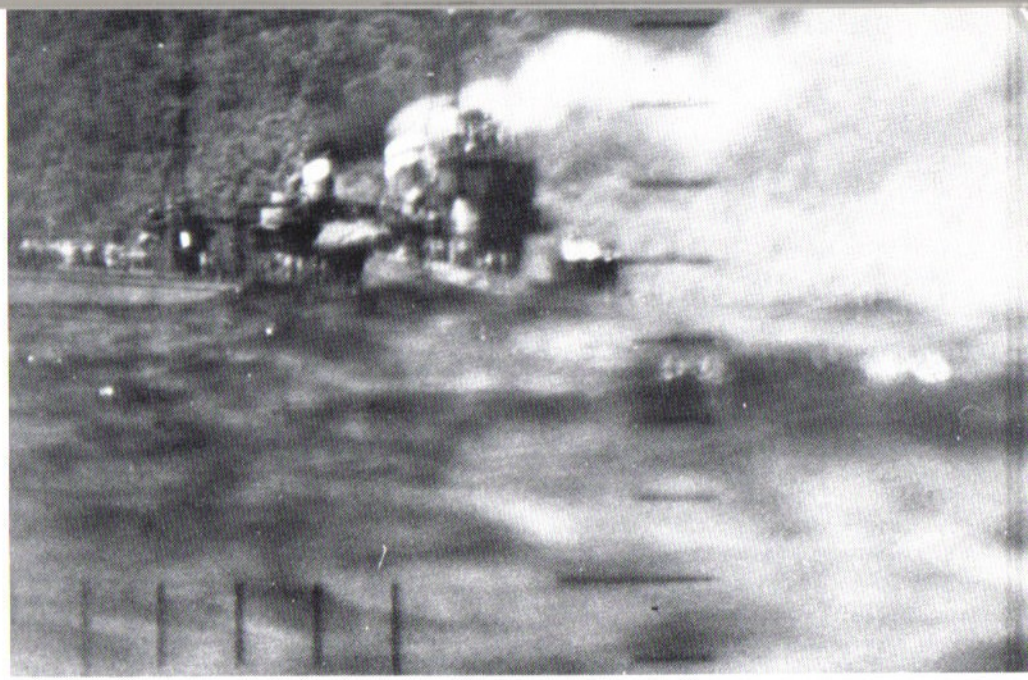


patrols under her first skipper, **Wahoo** was given to Dudley 'Mush' Morton, who in one patrol transformed a grumbling, restless crew into a spirited fighting unit. At the same time, he had a galvanizing effect on the Submarine Force as a whole, giving it a much needed shot in the arm and kick in the pants. He did it by taking chances, by sticking with a target until it was sunk, by bringing to the task of sinking ships a reckless enthusiasm that was contagious. He simply enjoyed sinking Japanese ships. On **Wahoo's** third patrol he nosed her into Wewak Harbor, New Guinea, damaging a Japanese destroyer, then caught up with a four ship convoy, sinking three of them. On the way home, of torpedoes, he even took on a small freighter with his deck gun, but got the short end of the encounter. During this patrol, Morton became involved in a highly controversial incident which, while it shocked some people, could not have stated more plainly Morton's attitude toward his 'job'. One of the ships that **Wahoo** sank on this patrol was a troop transport that she caught near the coast of New Guinea. Surfacing amid the survivors Morton ordered his deck gun into action, killing an unknown number of enemy soldiers, destroying all life boats and rafts. Morton's reasoning was that the survivors would probably have been rescued, or have made their way to shore, eventually to fight US troops on some battlefield. To Morton they were soldiers and it was his job to kill them. Neither Lockwood nor any higher commander raised any objection to his conduct. Some of his fellow skippers were shocked by what they considered to be barbarous conduct. That incident notwithstanding, **Wahoo** and Morton returned to Pearl Harbor wrapped in instant glory, a broom tied to the shears to indicate a clean sweep. 'Mush' Morton's brand of relentless aggressiveness was just what the doctor ordered.

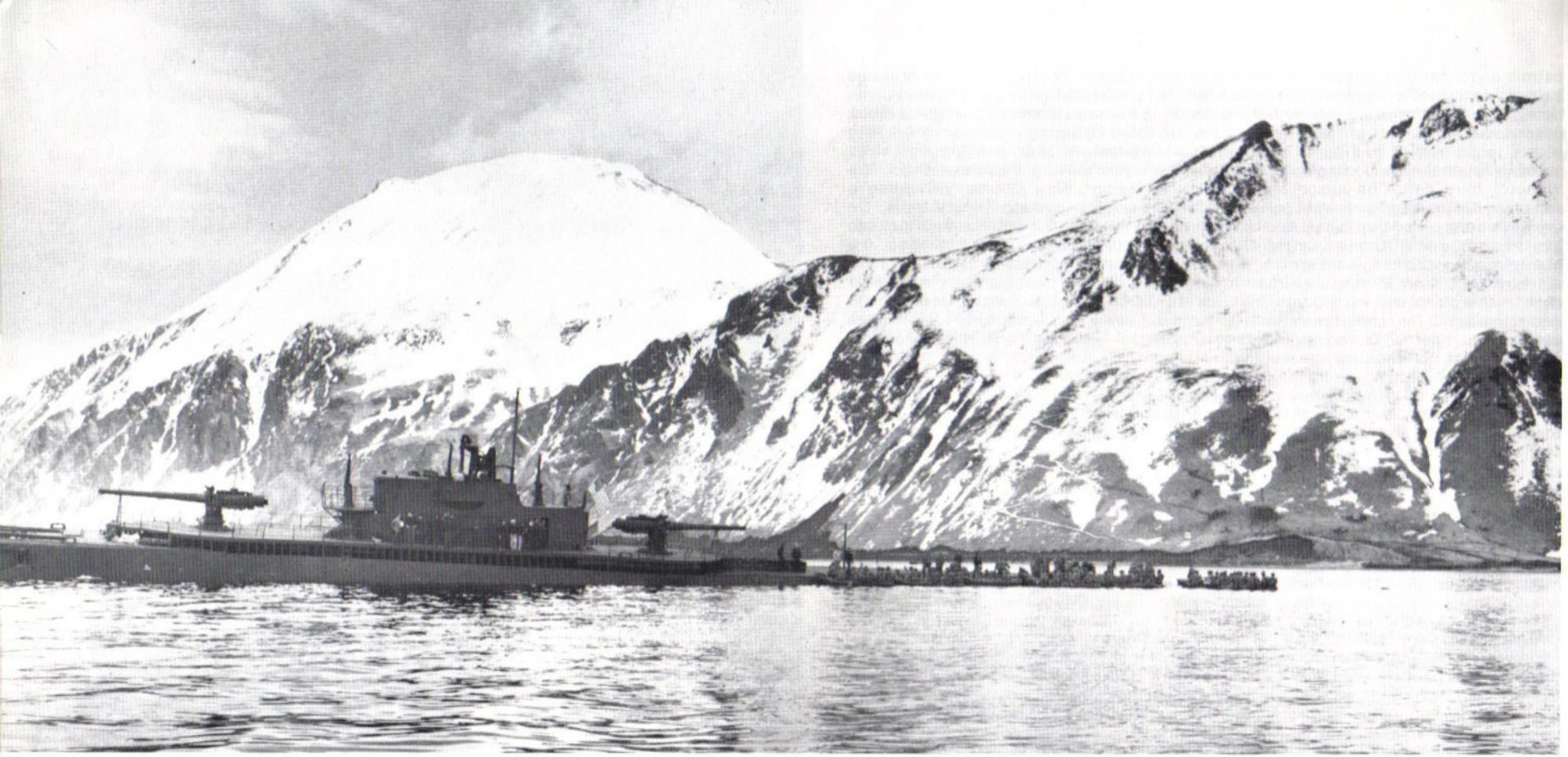
Early 1943 saw the first, tentative steps toward 'wolf-packing' by US subs. The use of wolfpacks, or co-operative attack groups, was the primary reason for the success of the U boat offensive in the Atlantic. Submarine Force staff was aware that German success would have been much diminished had they employed the independent patrol tactics used by US boats in the Pacific. Still there was great resistance at all levels to altering that pattern. Having been informed of a newly discovered Japanese convoy assembly area north of Rabaul, Fife decided to dispatch three two-ship groups between March and June to test the theory of co-operative attack. The results were hardly overwhelming as they managed to sink only four ships between them. Part of the blame for this poor showing goes to the constantly improving Japanese anti-submarine defense, but most must go to a lack of experience in multiple boat operations at all levels of the Submarine Force. No tactics were worked out in advance and no communication was allowed between the boats. The only way they could talk was through Fife and most skippers were understandably reluctant to radio Brisbane too often. In fact, the proximity of a second boat whose exact location was not known inhibited most skippers out of fear of torpedoing or being torpedoed by their partner.

Torpedo problems began to come to a head again at this time. Now it was the exploder that was the culprit. Simply stated the problem was that the magnetic feature worked only part of the time. When it was faulty the torpedo would not explode because it would pass under the target. Yet if the torpedoes were set to run shallower in order to use the contact exploder as a back up, then the torpedo might well detonate prematurely if the magnetic exploder was working that time. The most outrageous example of this occurred when **Tunny**, under CO John Scott, maneuvered into the middle of a formation of three Japanese aircraft carriers on 8 April 1943. Setting his torpedoes to run shallow because of repeated failures of the Mk VI exploder, Scott watched in horror as six of the full spread of ten torpedoes prematured because the magnetic feature chose this occasion to work. Three of the remaining four missed, only one hit. *Taiyo* was damaged, *Hiyo* and *Junyo* escaped unharmed. Still nothing was done. Even Lockwood deferred to BuOrd's insistence that there was nothing wrong with the Mk VI, that it was simply not being used properly. Alone among US skippers 'Mush' Morton had no complaints about the torpedoes. On his next patrol **Wahoo** sank nine ships for 20,000GRT in the Yellow Sea.

Wahoo's fifth patrol, Morton's third, was to prove decisive in the solution of the torpedo problems. On this patrol to the Kuriles, **Wahoo** sank three ships but at least



The fortunes of the Submarine Force were at a low ebb when Dudley W. 'Mush' Morton took Wahoo **on an almost recklessly aggressive third patrol. (Above) Told to investigate the shipping at Wewak, Morton took** Wahoo **nine miles into the harbor, torpedoing this Japanese destroyer which was saved from sinking only by being beached. (National Archives) (Right) 'Mush' Morton, on the right, and Dick O'Kane, his exec, are seen here on** Wahoo's **bridge. (National Archives) (Below) Off Mare Island,** Wahoo **is seen after a major refit before her sixth patrol. 14 July 1943. (SFL)**



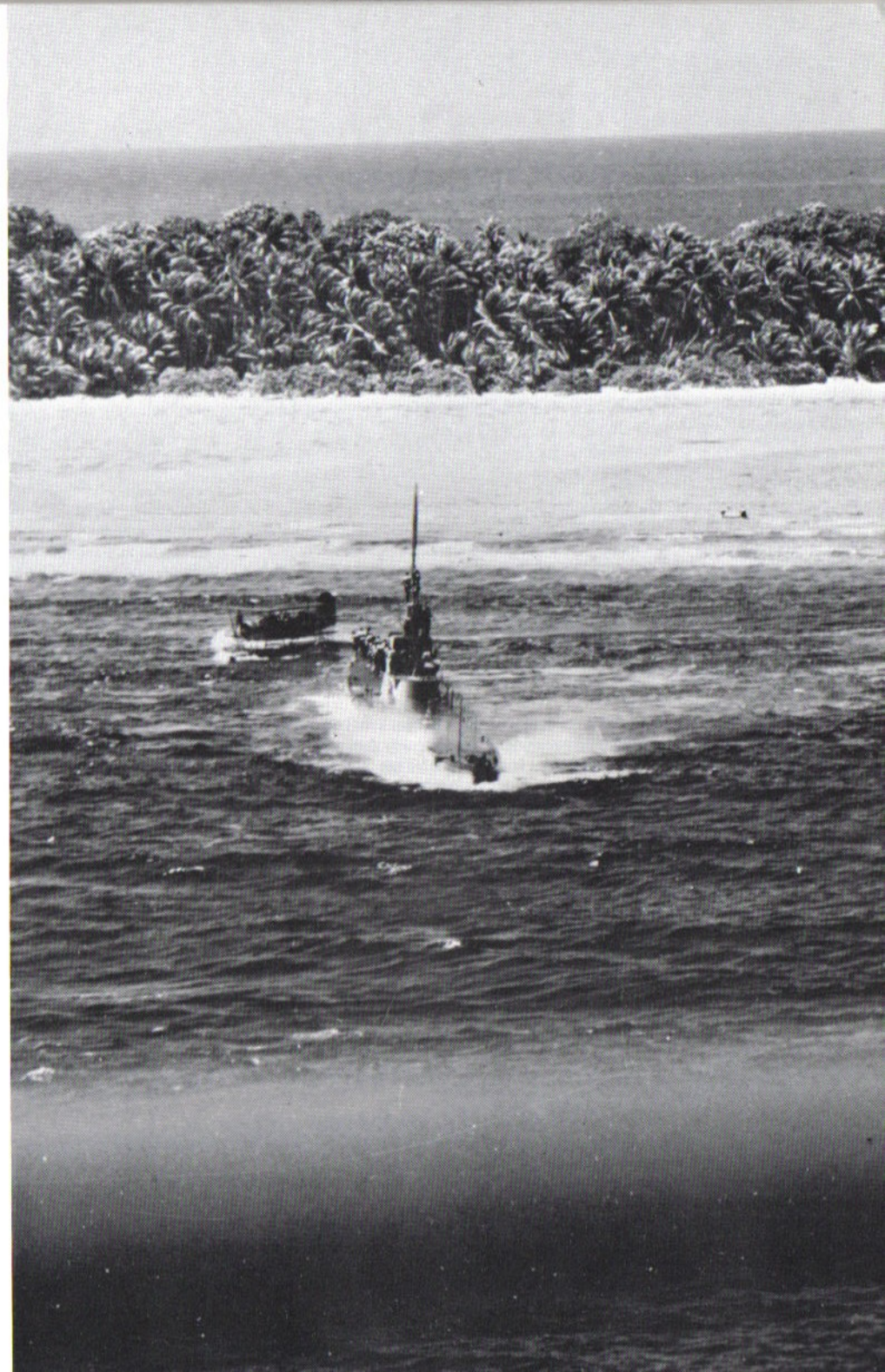
Following the 'success' of the Makin Island raid, Nautilus, **this time in conjunction with** Narwhal, **was assigned another similar mission. The target this time was Attu and the raiders were Willoughby's Provisional Scout Battalion of the 7th Infantry Division. In this view, the raiders practice launching their rubber rafts off the partially submerged stern of** Nautilus **at Dutch Harbor, 30 April 1943. The landing was carried out flawlessly on the night of 11 May 1943. (National Archives)**

three more got away because of torpedo failures. Upon his return Morton informed Lockwood of exactly what he thought of the Mk VI exploder and its magnetic feature. Many skippers had lodged similar complaints before, but 'Mush' Morton's status as the most celebrated skipper in the Pacific added the weight that was necessary. Lockwood's patience was finally at an end. On 24 June he ordered that the magnetic feature of the Mk VI be disconnected. The commanders in Australia disagreed with Lockwood's conclusions, ordering their boats to continue using the magnetic feature. But they now represented less than a third of the Submarine Force, having 20 boats split between the two bases while the Pearl Harbor force now numbered over 50. For most US submarines, at least, the torpedo problems should now have been solved.

They should have been but were not. One more chapter remained. This one would have been funny had it not been so sad. On 24 July 1943 **Tinosa,** under CO Dan Daspit, intercepted and attacked the 19,000GRT whaler turned tanker *Tonan Maru III.* Daspit ordered four bow tubes fired at his target. The magnetic feature having been disconnected, they were set to explode on contact. Two hit, as evidenced by large water splashes, but the target showed no sign of slowing down. Two more torpedoes were fired, both hit, one aft caused noticeable smoke. The target now slowed and began to settle aft but showed no sign of sinking. Then the fun began. Determined to sink this juicy target, over the next 21 minutes **Tinosa** fired nine more torpedoes into the motionless target. In each case a splash was seen at the point of impact but no explosion was heard. 13 out of 15 torpedoes had hit the tanker but she was not in any danger of sinking. Saving his last remaining torpedo to be examined back at the base, Daspit turned **Tinosa** for home. For Lockwood, this was the last straw. He ordered one of his new boats to fire torpedoes at a nearby vertical cliff-face until a dud was obtained. Upon examination, the exploder was found to have crushed before the firing pin could strike the explosive cap. The splashes that Daspit saw when his torpedoes hit *Tonan Maru* had been the air flask rupturing. Only one out of 13 torpedoes had actually exploded. Further tests on land proved that if the torpedo hit its target at a 90° angle, the exploder failed almost every time. As the angle increased, so did the chance of explosion. The better a sub set up its target, the less likely it was to get a sinking. A field fix involving a stiffer firing pin brought immediate relief to the problem. Almost two years into the war, the Mk XIV's major problems were at last solved, always in the face of considerable resistance from BuOrd. Finally US subs were to be sent out armed with a fairly reliable weapon. Now was the time for results.

In July 1943 Lockwood decided that the Pacific Fleet Submarine Force was strong enough to penetrate previously forbidden waters, the Sea of Japan. This narrow sea lies between Japan and China and is virtually land locked. It was believed to be teeming with traffic. Three boats, veterans **Permit** and **Plunger** and the new **Lapon,** were dispatched for the first foray. The results were disappointing. Between bad luck and bad judgement the three subs managed to sink only two small freighters and damage another. In August a second attempt was made. **Plunger** returned for a second try along with **Wahoo. Plunger** accounted for three small ships. **Wahoo**, without XO O'Kane, was trying out a new experimental firing scheme and had no success at all. Angered at his failure, Morton returned again in September, this time with success. Postwar records credit **Wahoo** with four sinkings, but she never made it home. She was probably sunk by a Japanese aircraft on 11 October while trying to exit through the La Perouse Strait. At the time of his death, 'Mush' Morton was the leading 'ace' among US skippers. By war's end he had dropped to third position, being surpassed only by Slade Cutter in **Seahorse** and by his own exec Dick O'Kane in **Tang.**

Harder **and her only CO, Sam Dealey, gained fame as the 'Destroyer Killer' because she sank four Japanese destroyers including three in a four day period in June 1944. (Below) Dealey, third from the left, and** Harder's **wardroom are standing behind the boat's warflag. Most US subs carried a warflag, created by the crew to display the boat's insignia (usually a cartoon showing the fish after which the boat was named in an aggressive pose) and the boat's war record. When these first appeared about midwar, they were relatively simple affairs.** Harder's **warflag, seen here in late 1943, shows the insignia, motto and a star for each patrol. (US Navy via SFL) (Right)** Harder **nudges dangerously close to shore during a lifeguarding mission, Woleai Is., 1 April 1944. A pilot came down on Woleai, being forced into the trees by snipers.** Harder **came in close to launch a raft with two crewmen, barely visible on the beach. The floatplane came down to help but managed to cut the lifeline to the raft. The rescue was eventually completed successfully. (National Archives)**



Three of 22 Navy aviators picked up by Tang **on her second patrol spent lifeguarding off Truk, April 1944. Under CO O'Kane,** Tang **went on to become the second most successful boat in number of enemy sunk. (National Archives)**

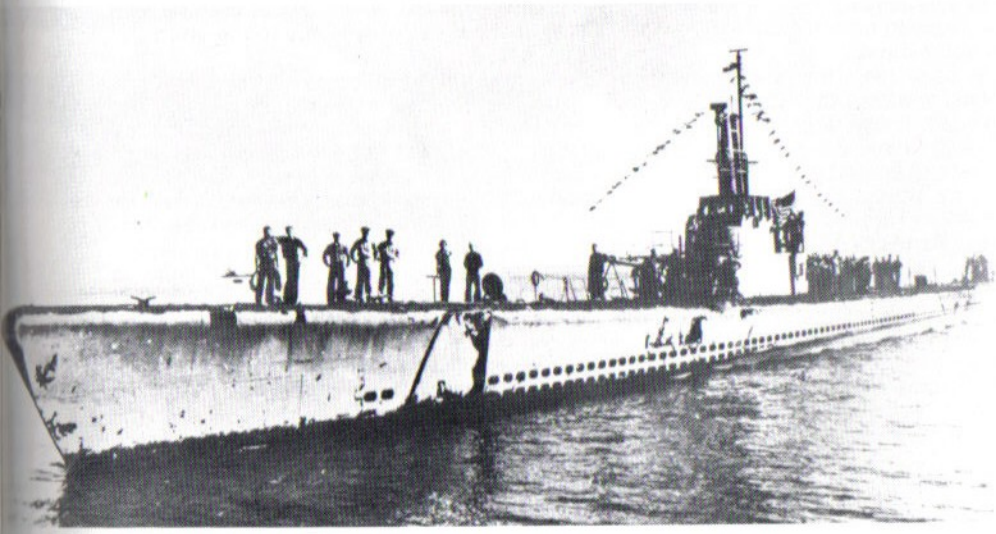
Submarines based at Brisbane made some further halting efforts at co-operative tactics during November 1943. Despite fears at command levels, four boats (**Gato, Peto, Raton** and **Ray**) converged on a convoy between Palau and Rabaul. The results were much better this time, four out of five ships being sunk. Regardless of this success and that of a similar effort in December, such concentrations of firepower were rarely exploited. In part this was because Japanese convoys rarely reached the size of Allied convoys, so that wolfpacks that were common in the Atlantic would have not been as practical in the Pacific. Another factor was the very size of US subs. The Submarine Force was fighting the war with fewer, bigger boats than their German counterparts. One unfortunate result of this was an inordinate fear of losses. At the beginning of the war, when America could deploy fewer than 40 boats, such caution was understandable, but by November 1943 this situation had changed dramatically. In spite of the loss of 22 boats since the war began, US commanders could now commit more than 95 boats, with new construction arriving at the rate of four per month. It would seem as if the time for caution had passed. The willingness to accept reasonable losses is essential, particularly among submarine commanders who must send fragile boats repeatedly into danger in order to achieve results. German U boat command had this willingness, balking only when the odds of returning from patrol dropped well below even. For better or worse the Submarine Force never achieved this coldbloodedness.

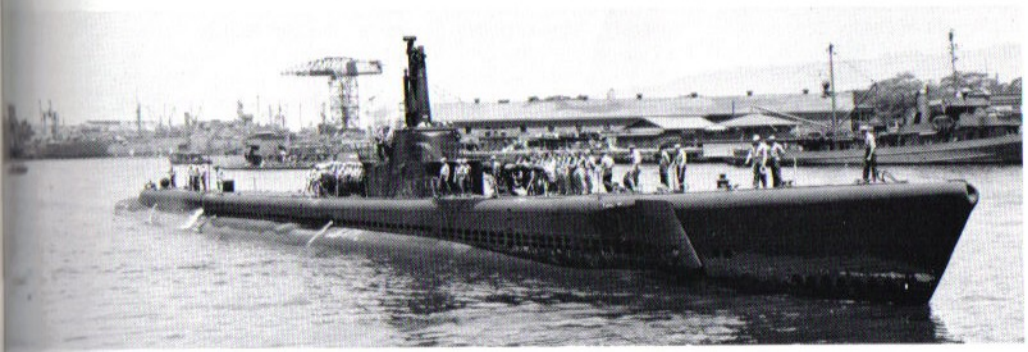
The final months of 1943 saw further improvement of the position of the Submarine Force relative to the enemy. The overall size of the fleet continued to grow as new construction far exceeded losses. The Japanese still held a decided edge in warship sinkings because of their concentration on this type of target as opposed to merchant vessels. This situation was changing as the number and ability of US submarines were constantly increasing while their Japanese counterparts were being continuously diverted to transport duties. One of the last major victories by a Japanese submarine was the sinking of **Corvina** in November. For the first time the Submarine Force was seriously impeding the movement of goods around the Greater East Asian Co-Prosperity Sphere. Almost 1,500,000GRT of merchant shipping was sunk in 1943 causing a more than 15% drop in bulk imports to the Home Islands. Only in tanker statistics were the Japanese still ahead and this situation was being remedied. By the end of 1943 a number of oversights on the part of the Submarine Force were being corrected. The Luzon Strait was now being regularly patrolled and the crucial importance of tankers to Japan's war effort was realized. They now were priority targets. All in all Submarine Force staff had reason to be proud. The confusion and discouragement of just a year before had been replaced with a feeling of certain ultimate victory. It is a tribute to men like 'Mush' Morton and Charles Lockwood that this crucial transformation had taken place.

In late 1943 US subs were given a new task that was to become increasingly important as the war progressed, lifeguarding (picking up downed Navy fliers). The first submarine to be so assigned was the new **Skate**, under veteran CO Eugene McKinney, which lifeguarded at Wake during the carrier strikes there in October 1943. McKinney more or less wrote the book on how to lifeguard. The difficulty was that the sky outside the immediate strike area was still very much enemy controlled, meaning that each time a rescue was attempted the whole boat and crew was endangered. McKinney worked out a system in which the boat surfaced 'flooded down' with only the bridge and bow out of the water and only four men topside. As it was, one **Skate** officer was killed by a strafing Zero, but six aviators were rescued who might otherwise have drowned or been captured including Lexington's CAG. The experiment was declared a success. In all future carrier air strikes, subs were assigned lifeguarding duty. 380 Navy aviators were rescued by 86 boats before war's end.

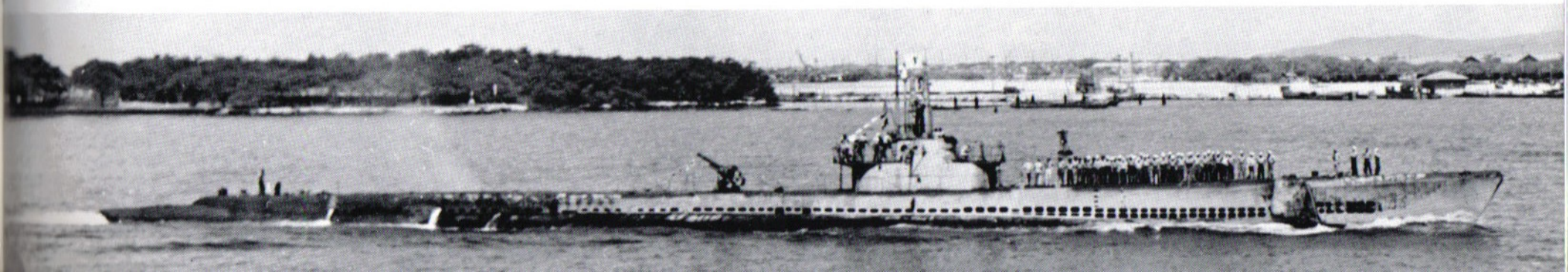
One of the more ironic tales of the war occurred in late 1943. The story begins when **Sculpin**, a veteran boat on its ninth patrol, was sunk by a wily Japanese destroyer commander and a malfunctioning depth gauge. She broached next to *Yamagumo* and was sunk by gunfire. Half of the crew made it into the water and was captured. (The second Medal of Honor to be given to a submariner went to Division 43 CO Cromwell who was on board **Sculpin** as an observer. Realizing that if captured he might, under torture, reveal the secrets of 'Ultra', he chose to stay with the sinking sub.) **Sculpin's** survivors were taken to Truk, where half were placed on the escort carrier *Unyo* and half on *Chuyo* when these ships sailed for the Japanese mainland. The convoy passed through the area being patrolled by **Sailfish. Sailfish** had been launched as **Squalus** but had sunk due to design faults, half of the crew surviving largely due to the efforts of **Sculpin** which located the sunken **Squalus** and stood by until rescue vessels arrived. **Squalus** was raised and renamed **Sailfish**, but was always considered a 'jinxed' boat. **Sailfish**, sometimes maliciously nicknamed **Squailfish**, sighted and sank *Chuyo*. This was the first Japanese aircraft carrier sunk by a US submarine. With justifiable pride, **Sailfish** returned to Pearl Harbor confident that the jinx had been broken. They did not learn until after the war that in sinking *Chuyo*, they had killed half of **Sculpin's** survivors.

By the end of the first half of 1944, the outcome of the Pacific War was no longer in doubt. With the Battle of the Philippine Sea, 'The Great Marianas Turkey Shoot', in June the back of the Japanese fleet was broken. Three of Japan's five remaining fleet carriers were sunk, two of these by submarine (Kossler's **Cavalla** sank *Shokaku* and Blanchard's **Albacore** sank the new *Taiho*). As a result of this, together with the tremendous aircraft losses, Japan's naval aviation ceased to be a factor in the outcome of the war. One more major naval battle remained (Leyte Gulf in October) but the outcome could no longer seriously be in doubt. By June the submarine offensive against Japan's tankers had forced the Japanese to base their main fleet at Lingga or Tawi Tawi, closer to the Borneo oil fields. There the Australia-based boats had an easy time keeping track of enemy movements. Between this surveillance and codebreaking, the Japanese couldn't make a move without Pacific Fleet's knowledge. Further, the reduction in fuel supplies caused the Japanese to sharply limit the training of their largely green carrier pilots. This lack of training was a major factor in the one sided result of the 'Marianas Turkey Shoot'. This offensive against the tankers had one additional crucial side effect. In an





A gallery of famous boats. (Top Left) Silversides **is seen off Mare Island, 21 August 1944, following refit. Under three COs, she went on to become third best in number of ships sunk and fifth in tonnage. (US Navy via SFL) (Above Left) With pennants flying,** Trigger **is seen in late 1944.** Trigger **was seventh on the tonnage list and eleventh in sinkings, but gained her fame primarily as the boat upon which Edward Beach, author and submarine advocate, served as XO for her first nine patrols. She was lost on her twelfth patrol in the East China Sea, 23 March 1945. (US Navy via SFL) (Left) Entering Pearl Harbor after her second patrol,** Tang **carries the 22 airmen she picked out of the water off Truk. On her fifth patrol,** Tang **sank seven ships and then herself. Her CO, O'Kane, wound up on top of the scoring list for skippers. (National Archives) (Above)** Flasher **is still in her early war overall black, 4 November 1943. She was the most successful in tonnage sunk and was fourth on the ships sunk list. (National Archives) (Below)** Spadefish **flies her flags, Pearl Harbor, 4 July 1945. She had good reason to be proud. In five war patrols she rose to fifth in ships sunk and sixth in tonnage. (National Archives)**



attempt to reduce the length of their tanker routes, and to save time, the Japanese began to use unrefined Borneo crude oil to fuel their ships rather than the more normal refined fuel oil from Java or Sumatra. But Borneo oil, which comes from the ground lighter and cleaner than most naval fuel oil, contains several volatile elements that lead to the formation of extremely explosive vapors. Tankers carrying Borneo oil were more likely to explode or burn than those carrying refined oil. (This was directly involved in the loss of *Taiho* at the Battle of the Philippine Sea. She sank after being hit by only one torpedo because vapors from ruptured oil bunkers exploded in the hanger area.)

That the outcome of the war was now predictable did not mean that much hard fighting was not still in store. Some of that fighting was 'political' infighting among US war planners who greatly disagreed over the use and effectiveness of the submarine. Adm. King wanted to capture Formosa and let subs and the air forces bring Japan to her knees. In retrospect, this seems brilliant and, as events proved, might well have worked. However this would have dropped Gen. MacArthur to the role of a bystander and forced him to renege on his 'promise' to return to the Philippines. At his insistence the original plan to slug through the Pacific via the Palaus, Yap, the Philippines, Formosa, Iwo Jima, Okinawa and eventually the Home Islands was maintained. The Navy was able to have a few of these stops deleted but had lost the battle for strategy. As a result an increasing number of submarines found themselves being diverted from the shipping war to other tasks (special missions, scouting, lifeguarding, photo reconnaissance). The war was needlessly prolonged and made needlessly bloody. It is pointless, but nevertheless interesting, to speculate whether the Atomic Bomb drops of August 1945 would have been necessary had the submarines and air forces been given free reign from new bases in the Mariannas and Formosa.

By mid-1944 Japanese shipping was being sunk at a rate of better than 50 ships per month. Imports to the Home Islands fell well below the level that could sustain a successful war effort. This represented an increasing number of patrols by over 140 boats against increasingly intense Japanese ASW defense which reached a peak of effectiveness at this time.

The advance of US forces across the Pacific drove the Japanese to desperate plans. Despite the decimation of their carrier aviation, the Japanese intended to resist the next major American move with their entire fleet. US subs were fully prepared to counter any Japanese response. Pearl Harbor boats now had advance bases at Majuro and Saipan at which to refuel and resupply, saving precious transit time. Likewise, Asiatic Fleet boats had a new base at Mios Woendi. While Nimitz' fast carriers were making preliminary strikes at Okinawa, Luzon and Formosa, submarines were lifeguarding and scouting. As always with submarines the results of this scouting were mixed. When in the right place a submarine makes an ideal scout, silent and virtually undetectable. 15 miles in either direction and it can miss the whole show. So it was on this occasion. Shima's cruiser force was seen by no fewer than nine US subs, none of which could get in a shot at the fast moving target as it headed into the Luzon Strait. On the other hand Ozawa's carrier force, which was intended as a decoy, emerged totally unseen five days later. Similarly Kurita's battleship force left Lingga unseen, but the talkative Japanese kept the Fleet Radio Units at Pearl Harbor and Melbourne (FRUPAC and FRUMEL, successors to Hypo and its Asiatic Fleet sister unit, Cast) well informed of their progress. Submarines were posted along every possible line of advance. On the morning of 23 October this thoroughness paid off as **Dace, Darter** and **Bream** sank two heavy cruisers and damaged two others so severely that they never fought again. Two days later Ozawa's force lost a light cruiser and a destroyer to submarines. Combined with losses in surface engagements and air strikes, the Japanese Navy effectively ceased to exist.

In spite of Japan's utter inability to take any further offensive action, with the sole exception of Kamikaze attacks, US planners stuck doggedly to their timetables, proceeding to invade Luzon, Iwo Jima and Okinawa. Three more bloody campaigns were fought which in no way altered the enemy's will or ability to resist. Only Iwo Jima had the possible justification of being a necessary fighter escort base for the B-29s that were pounding the Home Islands. All this activity was frustrating to the Submarine Force which saw its boats being diverted from the decisive shipping war. They felt that the war could be won without the tremendous cost in American lives and naval shipping. What remained of the Japanese fleet was destroyed on the high seas by submarines or in their harbors by carrier air. During 1944, US subs had sunk seven Japanese aircraft carriers with severe damage to another. (During the same time period, carrier air sank four and damaged one.) Even more significantly between September 1944 and January 1945, the tanker tonnage carrying oil between Indonesia and Japan was reduced from 700,000 GRT to 200,000GRT almost exclusively due to the efforts of US submarines.

By early 1945, the pickings began to diminish. The very success of the submarine offensive meant that targets were being sunk many times faster than they could be replaced. Those targets that remained were generally small and cautious, hugging the coast of China or remaining in the Sea of Japan (which had not been penetrated since the loss of **Wahoo** in October 1943). The coast-huggers could be, and were, ferreted out only by daring incursions into shallow waters. (Most notable was **Barb's** foray into Namkwan Harbor, sinking one freighter, damaging others, in January 1945. For this foray, **Barb's** CO, Gene Fluckey, received the Medal of Honor.) In June, after experimentation with a new mine-location sonar, US subs returned to the Sea of Japan in strength. One sub was lost but 23 merchant and warships were sunk by nine submarines. The results were sufficiently encouraging that seven other boats made Sea of Japan patrols. An eighth had just penetrated the Tsushima minefields when the war ended. Had the war continued, there is every reason to believe that the Sea of Japan would have been swept as clean of Japanese shipping as every other sea.

Many submariners emerged from the war with the distinct impression that the submarine's role in the victory was not fully appreciated. Because of the very secrecy necessary in a force that was constantly operating in enemy territory, the Submarine Force had gotten little press coverage (being known as the 'Silent Service'). The headlines had gone almost exclusively to the flattops. Yet no other element could claim anything like the efficiency or effectiveness displayed by the subs. Along with only carrier aviation, submarines could rightly lay claim to being one of the essential elements in that victory. Yet the aircraft carrier ended the war as the undisputed queen of the fleet. After the war American submarines were allowed to languish, the postwar fleet being composed of refurbished wartime boats (the Guppies) and a few marginally successful new designs, until the emergence of the first nuclear submarine in 1954. Since that point the fortunes of the Submarine Force have taken a definite turn for the better, to the point that there is serious discussion in Congress as to whether fleet carriers are necessary, or can survive, in an environment populated by nuclear attack and ballistic missile submarines.

Looking over the stern of Spadefish, Tinosa comes to berth at the Sub Yard, Pearl Harbor, where it had all started nearly four years before. The full power of the Navy can be seen here. The aircraft carrier (one of which is visible just to the right of Tinosa) got the lion's share of the glory, but it was the submarine that did the dirty work. Having known much more intimately the danger of sailing alone into the enemy's waters, they had more reason to celebrate the end of hostilities. (National Archives)

S class*

The S class boats, the oldest US submarines to see combat service in World War II, were not designed for or well suited for the kind of war they found. They were pressed into service reluctantly, only because the Navy didn't have enough fleetboats to cover all areas that needed covering. The S boats were generally assigned to the least important, and least popular, theatres, which meant they frequently faced some of the dirtiest duty, particularly in the Aleutians and the Solomons.

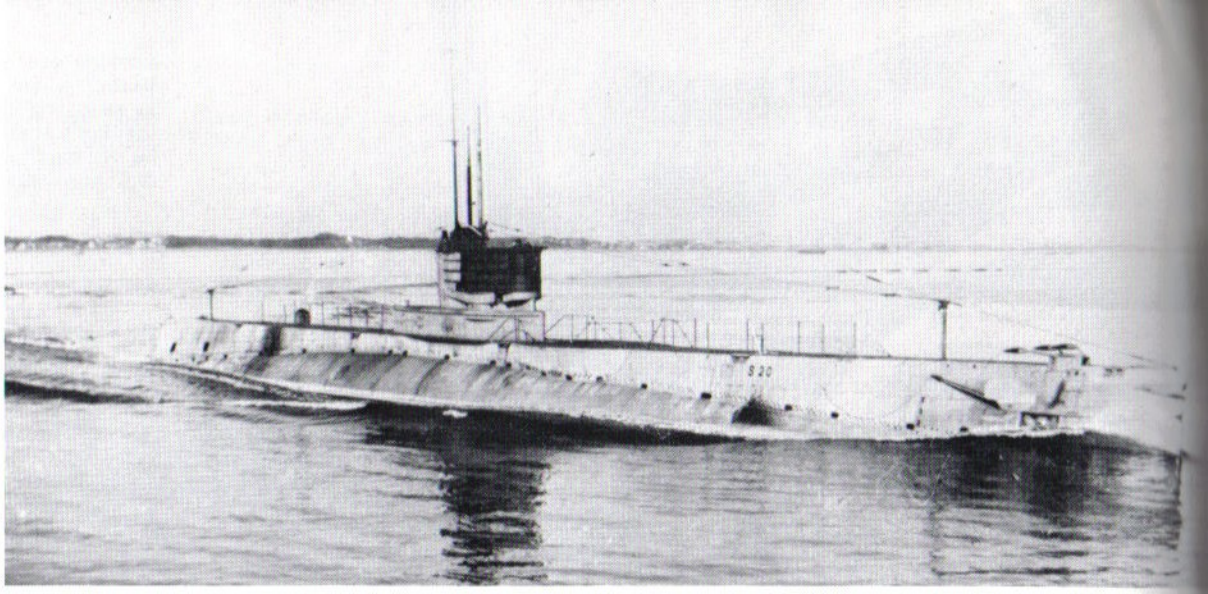
The design of the S class was a derivative of the wartime R class, calling for a slightly enlarged, 900 ton boat of 5000 mile range making it roughly equivalent to the German type VIIA. They had been designed with the Atlantic as their anticipated area of operations.

Out of an original class of 51 boats, 22 saw offensive action during the war. Of these, four were lost on patrol (only one, **S44**, to enemy action). As the war progressed the S boats were generally assigned to training duties, another being lost by accident while so engaged. At the end of the war, all remaining S boats were scrapped.

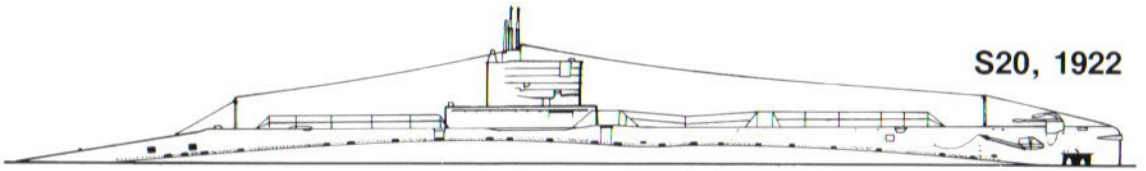
While utterly unsuited for the tasks to which they were put the S boats were nevertheless fought with courage and some skill. **S38,** under 'Moon' Chapple, and **S44** stand out, Chapple taking his boat into Lingayen Gulf during the Japanese invasion of the Philippines in a move that displayed considerably more guts than sense. That kind of reckless courage was sorely lacking in most skippers in the early days of the war.

*Three older or unsuccessful classes of US submarines were employed briefly in 1942 in patrols for the defense of the East Coast and the Panama Canal, and then were transferred to training duties. They made no Pacific patrols and sank no ships. These classes (the R, Barracuda and M classes) will not be treated in detail.

On a training cruise off Seattle S28 **is seen after having been withdrawn from the conflict after seven war patrols, 18 June 1943. The deck gun was added to S boats during the late '20s as a result of the German success with surface gun actions. The bridge has been extended to the rear allowing the mounting of a 20mm Oerlikon gun.** S28 **was lost in a training accident off Pearl Harbor, 4 August 1944. (National Archives)**

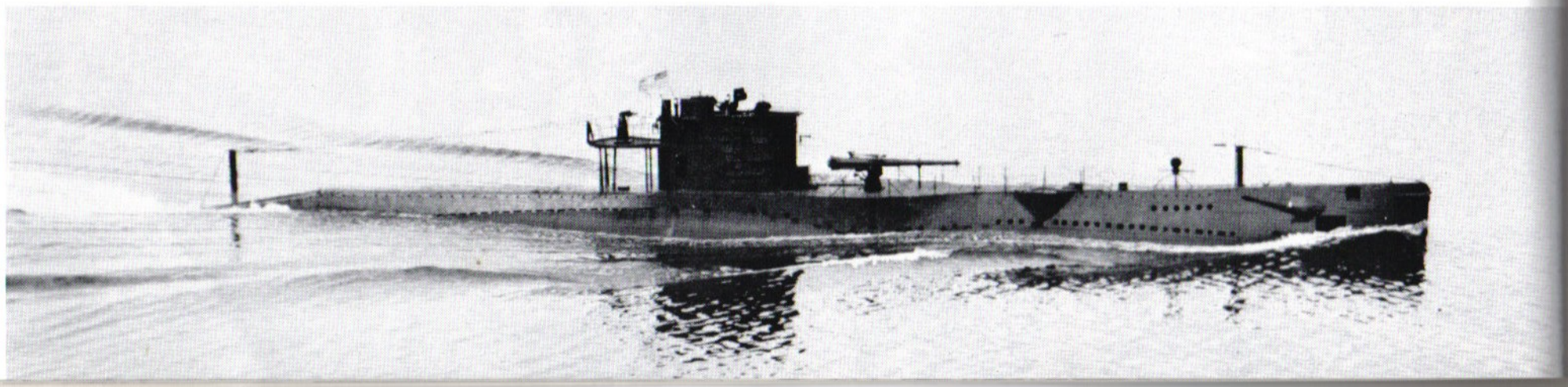


S20 **is seen on builder's trials off New London in 1920. Built to take advantage of experience gained in World War I, the S boats were soon rendered obsolete by the US Navy's shift of emphasis from Atlantic to Pacific. At the outbreak of World War II, they were too old, obsolete and short-legged to be effective but were forced into active service by the Navy's shortage of boats. (Electric Boat Co. via Dave Merriman)**



S20, 1922

S28, 1943



The Barracuda class subs, the Navy's first fleet boats, were considered to be too old and unwieldy for Pacific war patrols. At 2000 tons, they were more than twice the size of the S boats, but the design was not a success. They were never popular with their crews or the Navy. Employed briefly in the Atlantic in 1942, and after a plan for their conversion to transport sub was rejected, they spent the war as training boats. This photo shows Bonita **during the war with her deck gun removed and 'cigarette decks' fore and aft for 20mm guns. (National Archives)**

Argonaut

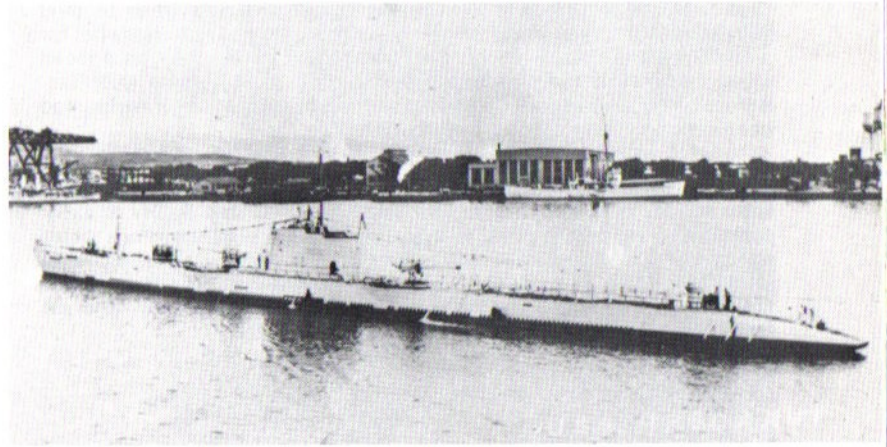
Derived from the preceding Barracuda class, **Argonaut** (**V4**) was the only purpose-built minelaying submarine in the history of the US Navy. Along with the three Barracudas, **Argonaut** was the first US fleet-type submarine, designed specifically with the Pacific in mind. She was better than three times larger than the S boats at 2700 tons and possessed an equally better range, 18,000 miles. Designed to be able to maintain fleet speed of 21kt, **Argonaut** had poorly developed diesels which never delivered much over half their rated power, limiting maximum speed to 15kt. It was this technical failure more than any change in tactical doctrine which led to the abandonment of the idea of submarines operating directly with the battlefleet, although the term 'fleet boat' stuck to all large, conventional US subs. The disastrous state of diesel design in the US was actually a blessing in disguise as it allowed the development of an independent strategy that proved itself gloriously during World War II.

Argonaut was never used in her designed role as a long-range minelayer. Her great size, which led to very poor underwater handling characteristics, and her large internal storage space caused her to be redesignated as a transport submarine after her first unsuccessful patrol. As such she took part with **Nautilus** in the Makin Island raid of 17-19 August 1942. Sent to Australia to carry out the many special missions demanded by Gen. MacArthur, **Argonaut** was ordered out on one last war patrol and was lost.

[A note on designations - the US Navy gave its early fleet boats a confusing array of designations. For example: **Argonaut** could be called by her name, her hull number (SS 166), her 'V' number, **V4** (early fleet boats starting with the Barracudas were loosely considered part of the V class) or her class number (**A1**, **Barracuda** was **B1**, **Narwhal N1**, etc.). Later on, her hull number was changed to SM 1 because of her minelayer design, and changed again to APS 1 when she was reclassified as a transport sub in 1942.]

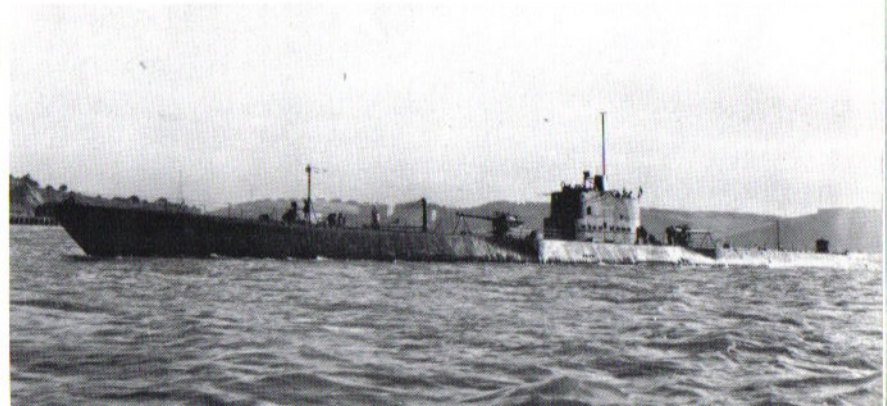
Argonaut, 1928

Argonaut, 1942



Argonaut, **carrying the designation** V4 **in small characters on her bridge and bow, is in her peacetime livery of Standard Navy Gray, a very light haze gray tone. Her broad stern is fitted with twin minelaying tubes. (SFL)**

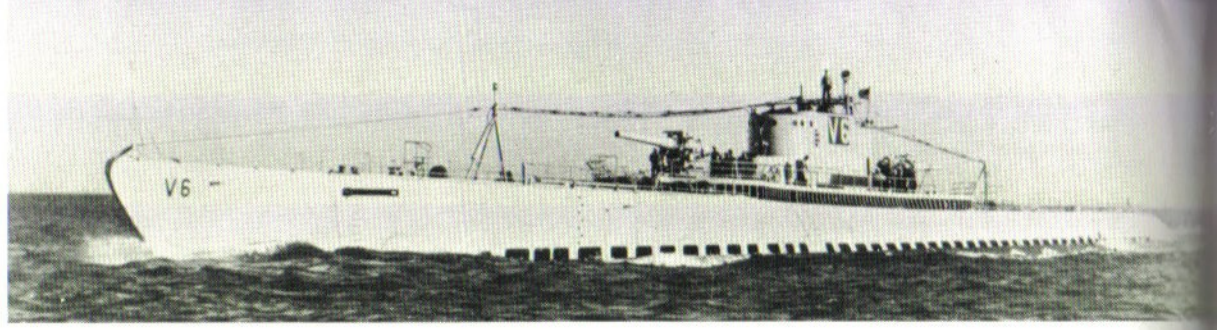
Dressed up in warpaint Argonaut, **as SM 1, shows few alterations from her prewar form. Her armament is unchanged, although the minelaying apparatus appears to have been modified, her shears have been extended and radars added. (US Navy via Floating Drydock)**



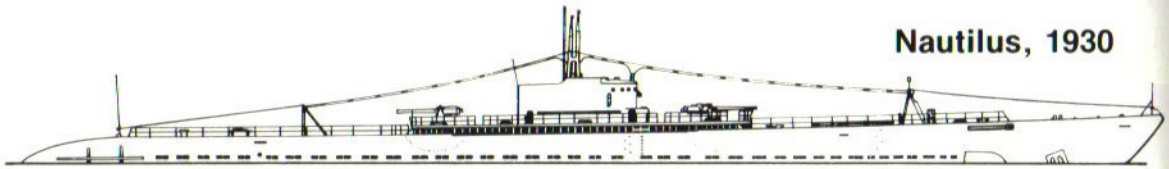
Narwhal class

The two boats of the Narwhal class were at least marginal improvements over the preceding four V boats. As with the other Vs, they were large, slow and unhandy, yet they did manage somewhat better performance (17kt) on a slightly larger displacement (2915 tons). As with the previous boats, their diesels never delivered rated power and their hulls were plagued with leaks.

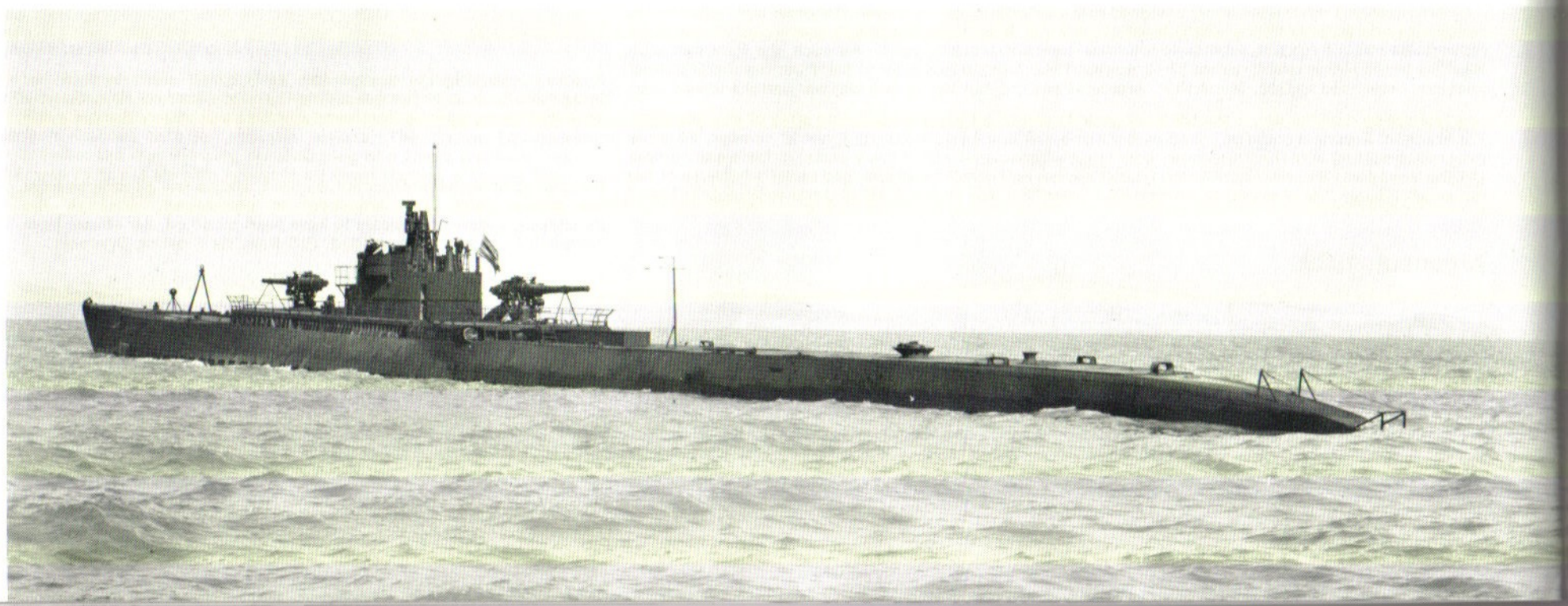
In spite of the weaknesses in the design, both boats served with distinction during the war. Both boats had four external torpedo tubes added, two at the bow and two under the raised deck amidships facing aft. **Narwhal** conducted five war patrols, sinking six enemy ships. **Nautilus** sank five in the same number of patrols. **Nautilus** then teamed with **Argonaut** transporting commandos to Makin and with **Narwhal** for a raid on Attu. Thereafter, both Ns were used continually on special missions, mainly the resupply or evacuation of Philippine guerillas. Before being sent to well earned retirement in early 1945, **Narwhal** had been sent on 15 patrols and **Nautilus** on 14.



Nautilus, as V6, **shows her size and unique design with raised deck casing amidships. At nearly 3000 tons, she was not exceeded in size in the US Navy until her namesake, the first nuclear powered submarine, was launched in 1954. (SFL)**



During the war Nautilus **and her sister were used as attack submarines, then as transports for raiding parties and finally to carry supplies to various guerilla forces. Besides the wartime black paint scheme, the most visible modifications are the gun platforms fore and aft on the tower. Two of her four external torpedo tubes can be seen. The inset for the port bow tube is barely visible at the left, the aft facing tube is visible amidships. (Floating Drydock)**

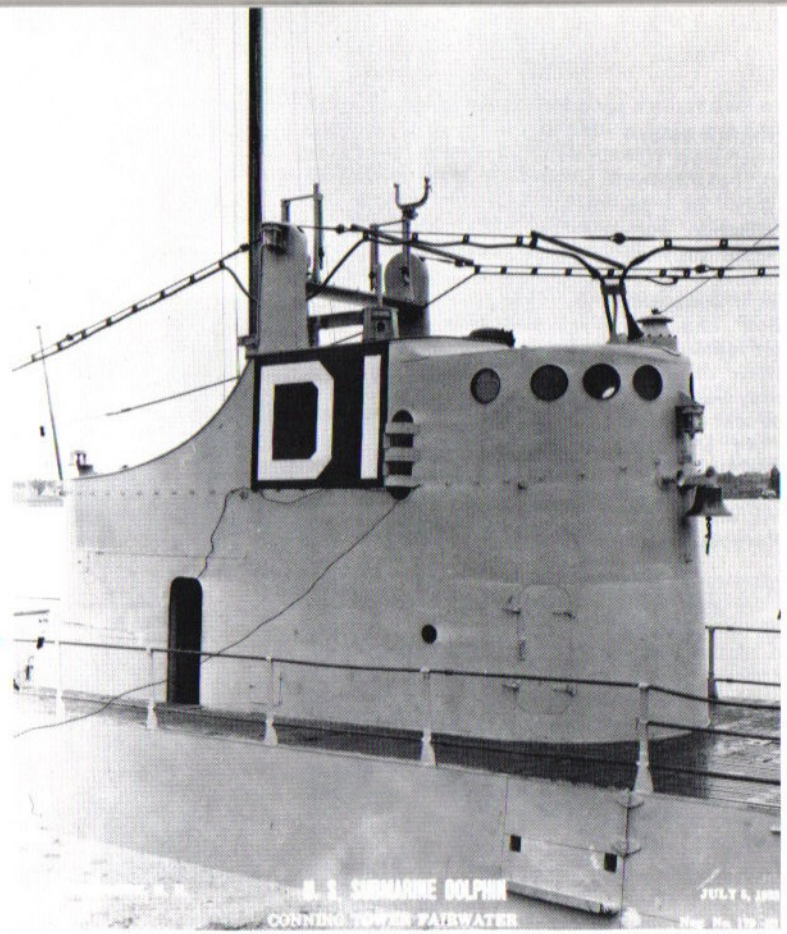


Dolphin

With the obvious failure of the six preceding boats to deliver the necessary performance, the US Navy began to look for other alternatives. One idea was to attempt to deliver the actual, as opposed to designed, performance of the Vs in a considerably smaller package. **Dolphin**, originally designated **V7**, then **D1**, was at 1560 tons just slightly more than half the size of **Narwhal**, yet was capable of the same speed and carried the same armament of six torpedo tubes. Being smaller, she was considerably more maneuverable and could dive more quickly.

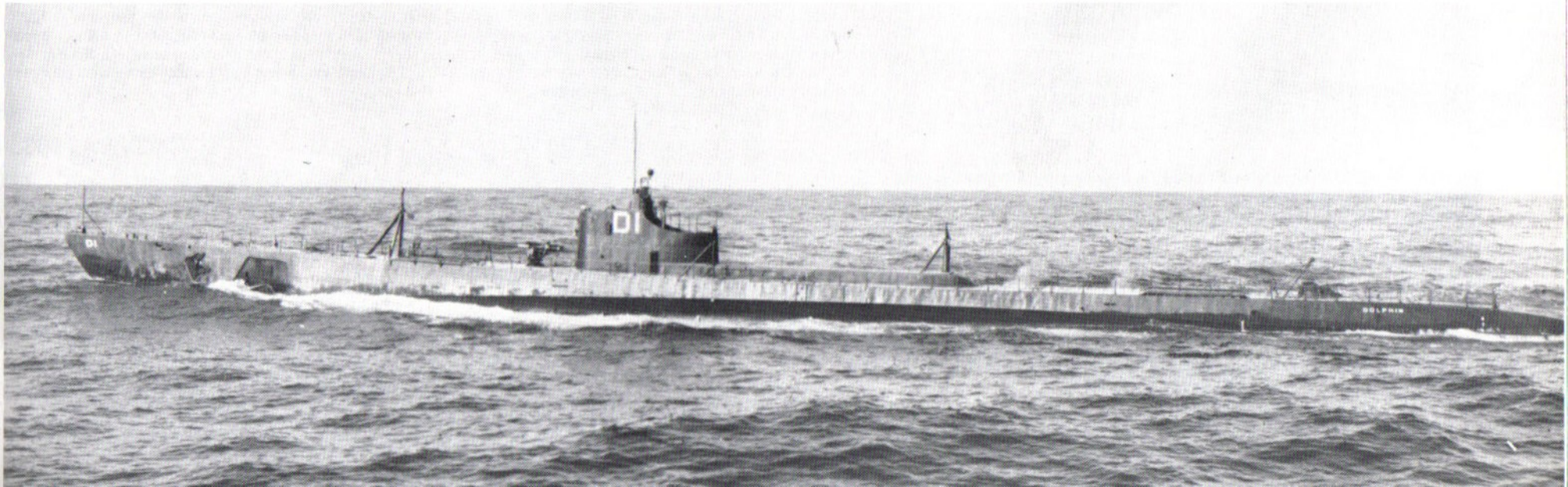
The idea was obviously a good one but the state-of-the-art in 1930 couldn't produce a medium-sized submarine without some major sacrifices. **Dolphin** had only half the range (9000 miles) of the last two classes and being of much lighter construction could not dive as deeply. While of much the same size as the wartime Gatos, **Dolphin** was operationally a failure, being transferred to training duties after three zero patrols.

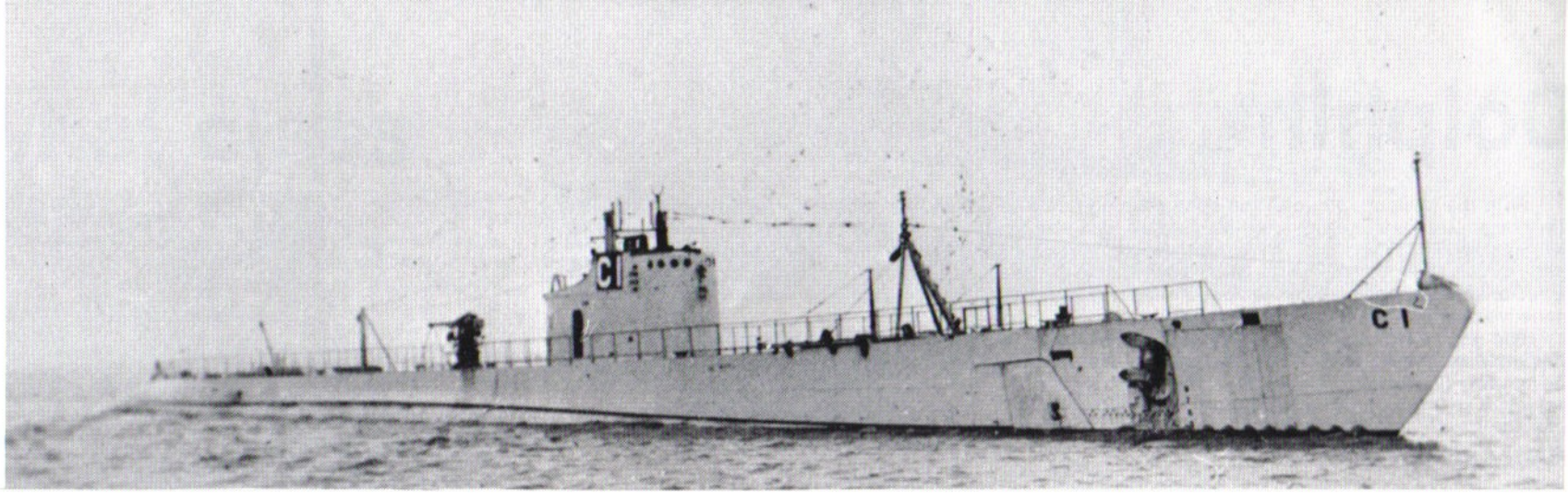
Dolphin, 1932



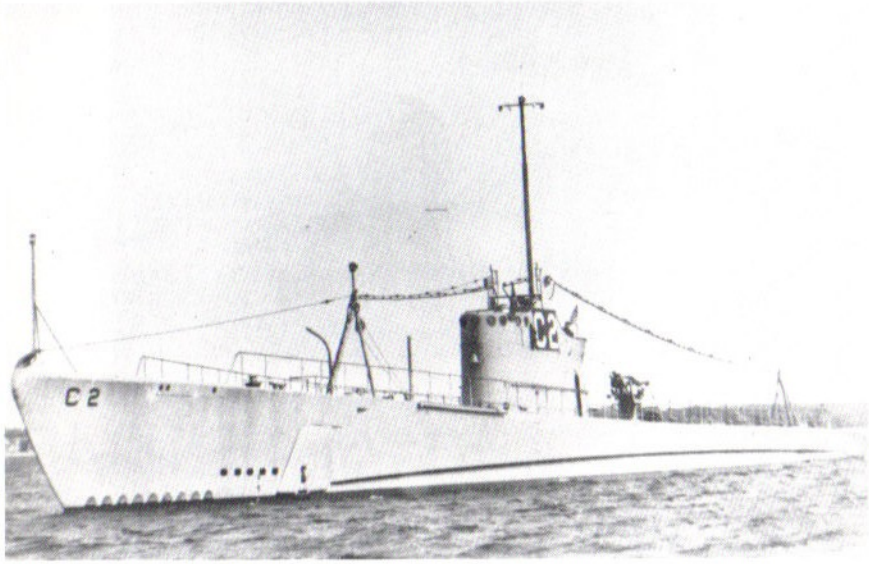
In reaction to the huge size of the Ns, Dolphin **was designed in an attempt to fit the same features into a much smaller displacement. This close-up of** Dolphin's **fairwater shows features typical of prewar subs, notably the twin radio masts on either side of the tower. (US Navy via Floating Drydock)**

During the late '30s Dolphin **appears in a coat of overall gloss black. She conducted three war patrols, then finished the war as a training boat without extensive modifications. After her second patrol off the coast of Japan, she developed a serious oil leak. Upon her return, 'Mush' Morton was scheduled to take her over but refused, calling her a 'deathtrap'. The incident nearly ruined Morton's career but after her next patrol she was retired for exactly the reasons Morton stated. (National Archives)**





(Right & Below) Cachalot **(C1 and** Cuttlefish **(C2) in 'as launched' configuration. With the use of welding in construction and improvements in their diesels, they were more successful than** Dolphin **despite a further reduction in size. (US Navy via SFL)**



Cachalot class

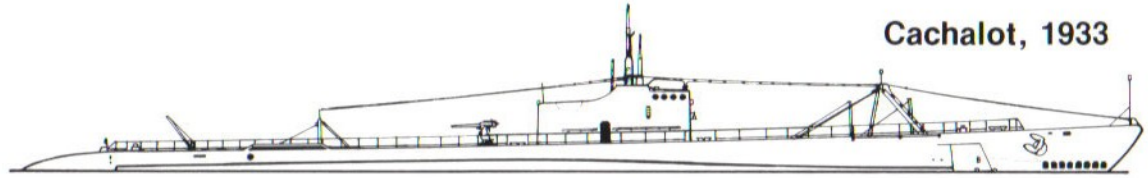
Cachalot (V8, C1) and **Cuttlefish** (V9, C2) were further attempts at producing a smaller, lighter submarine for use in the Pacific. At 1170 tons they were almost a third smaller than **Dolphin**, yet they were superior boats in many ways. They were designed to give up speed to gain range, though in practice they proved to be faster and shorter-legged than planned, ending up with almost identical performance as **Dolphin.** This still was not the 12,000 mile range considered the minimum necessary for a patrol from Pearl Harbor to Japan and back.

One notable innovation in the Cs was the extensive use of welding, particularly in the pressure hull and fuel tanks. Leakage, particularly of the oil tanks, had been the bane of all previous classes. (On one 30 day training cruise in 1941, **Narwhal** lost 20,000 gallons of oil from leakage.) Much more serious than the loss of the oil was the fact that it left a continuous slick behind the boat, making it easy to track from the air. The welding in the Cs was entirely successful, saving weight, adding strength and solving the leakage problem at the same time. A second major innovation was the introduction of the first TDC (Torpedo Data Computer). This was a mechanical analog computer which, given the target's range, bearing and angle on the bow, would automatically compute the target's course and set the proper gyro angles for the torpedoes. In these two areas, the US Navy found itself far in advance of all others.

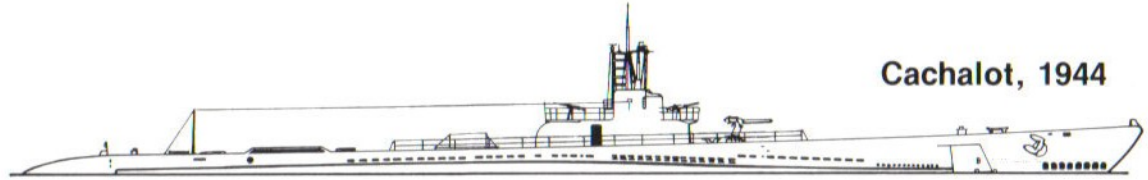
The Cs were too small to be truly successful in the Pacific. They each conducted three zero patrols and were turned over to training duties.

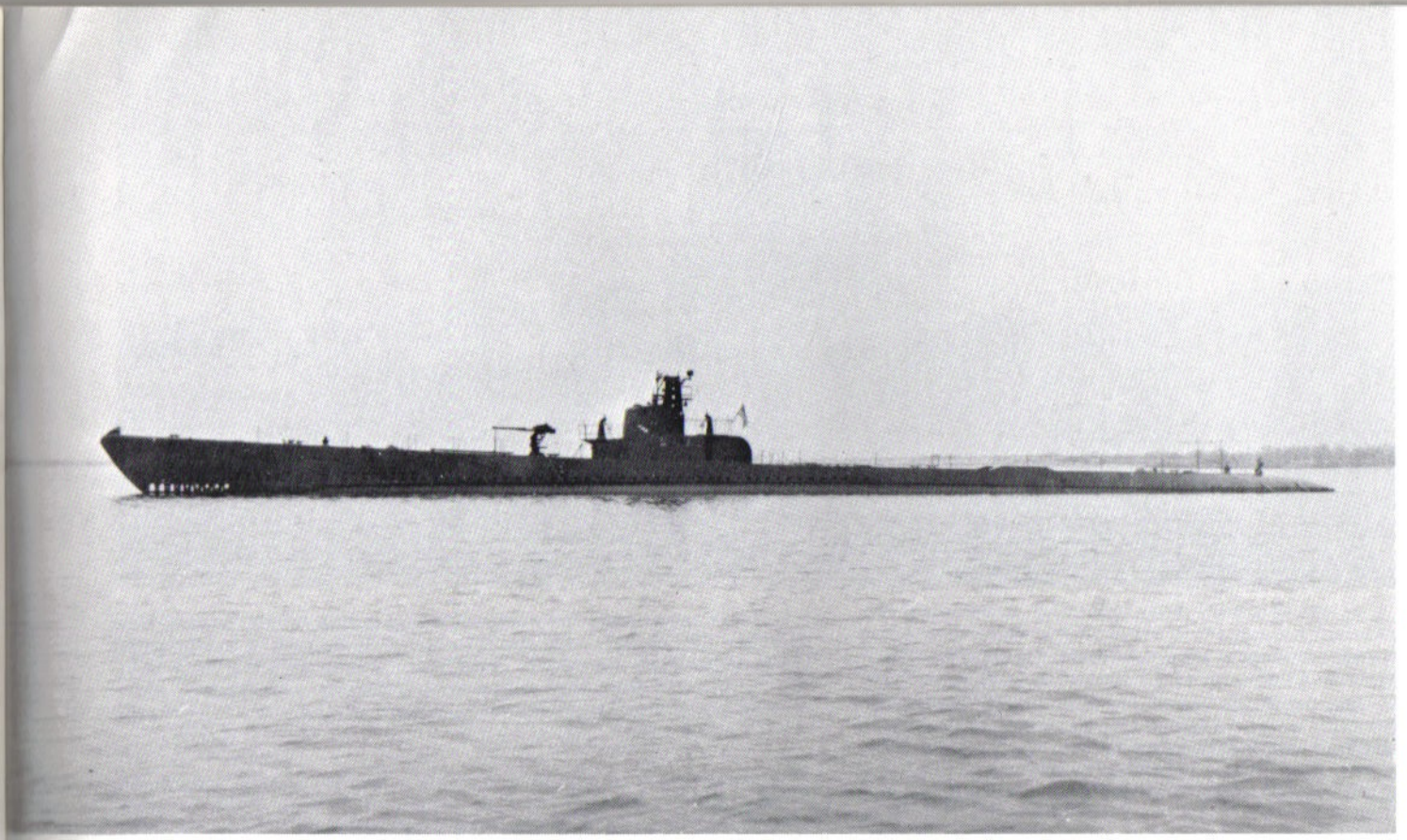
Prior to the war US submarines traded their light gray for gloss black and their class numbers for hull numbers. Hence C1 (Cachalot) **became 170 as the Navy prepared for war. (SFL)**

Cachalot, 1933



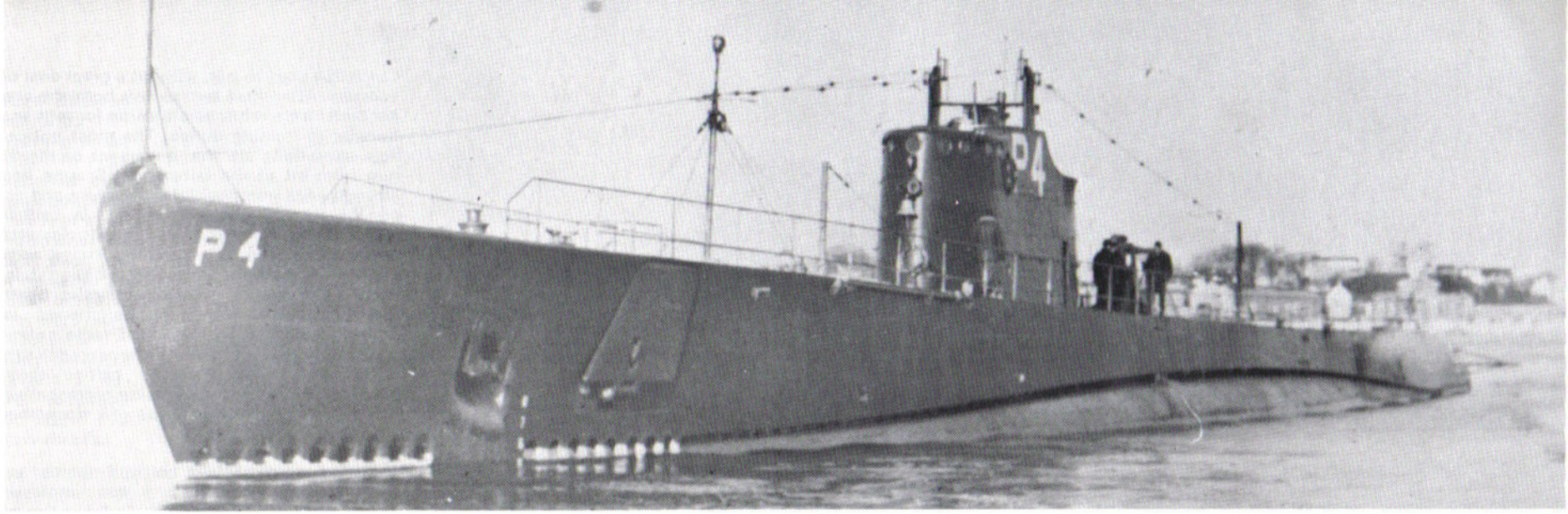
Cachalot, 1944





Cuttlefish goes to war, without a great deal of success. After three zero patrols both she and her sister were returned stateside for refit and transfer to training duties. The most noticeable alterations are the movement of the 3" gun from aft of the fairwater (US subs had strengthened gun positions both fore and aft of the tower allowing siting in either position) and the typical fore and aft cigarette decks with 20mm gun mounts. These were created by cutting down the existing fairwater. The existing shears (protective tubes for the periscopes) were heightened to provide positions for radar and radio antennas, most of which have been censored in this view. Note that Cuttlefish carries three painted flags on her tower side representing her war patrols. Philadelphia, 15 November 1943. (US Navy via SFL)

Cachalot again displays her hull number on her fairwater, now that she was employed exclusively as a training boat. As far as can be ascertained, no US sub carried such a marking on a war patrol. One further change that can be seen in this 31 May 1944 photo is the addition of numerous limber (free-flooding) holes along the side of the deck casing in an effort to reduce diving time by eliminating trapped air. US subs were notoriously slow diving, a condition made even worse by the cluttered shears of late war boats. (National Archives)



P class

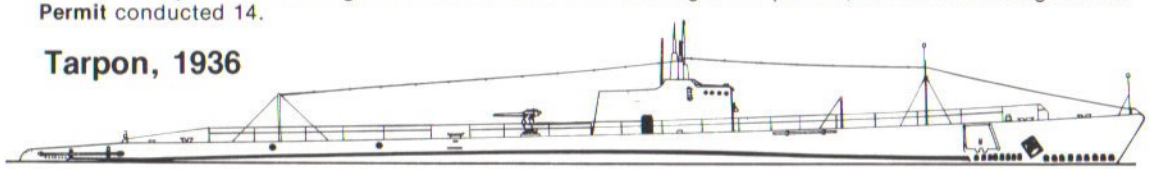
With the design of the P class in 1933, the US Navy began the line of development that would lead directly to the wartime Gato class. With the sole exception of the two small Ms, all US submarines up to the Tang class of 1951 evolved from the Ps. In comparison with the Cs, displacement was up 140 tons to 1310. They were 27ft longer at 301ft. Speed was increased to 19kt and range to 10,000 miles. They were entirely welded, from the third boat in the class. Seemingly in every respect the Ps were superior to all previous US classes.

Among the innovations in the Ps was the introduction of air conditioning. Besides an obvious increase in crew efficiency stemming from this, there was the additional benefit that electrical shorts, a common problem in submarines, were virtually eliminated. Also the P class introduced diesel-electric drive to US submarines. All conventionally powered US subs built since have been so powered. With this system, the main diesels did not directly drive the propeller shafts for surface propulsion, but rather drove generators which in turn drove electric motors that were also used for underwater propulsion. In this way, the commander could drive the sub at any variation in speed and charge the batteries while running the diesels at their single most efficient speed.

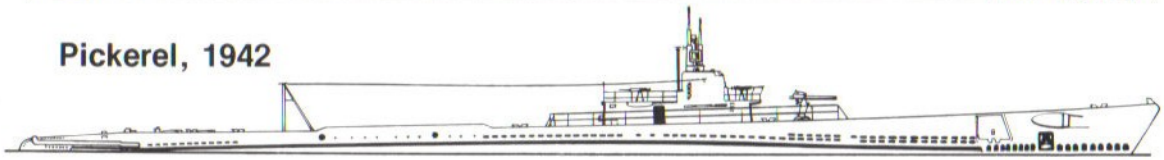
The armament of six torpedo tubes was generally considered inadequate. Some submariners, particularly a young division CO named Lockwood, felt that a boat the size of the Ps should carry more punch. In response to this, five of the Ps had two external tubes added at the bow after the outbreak of war. Three boats also had their total load increased from 16 torpedoes to 18.

The Ps served with distinction throughout the Second World War. They served in the front-line from Pearl Harbor until being gradually withdrawn from early 1944 on. Four of the 10 were lost due to enemy action. Nearly all the surviving boats had conducted at least eight war patrols, considered a long career. **Permit** conducted 14.

Tarpon, 1936

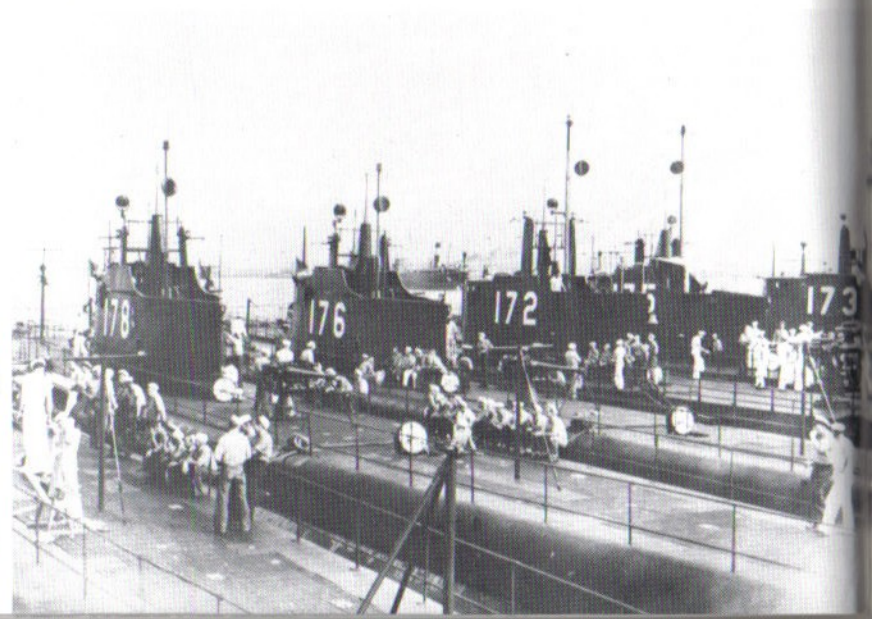


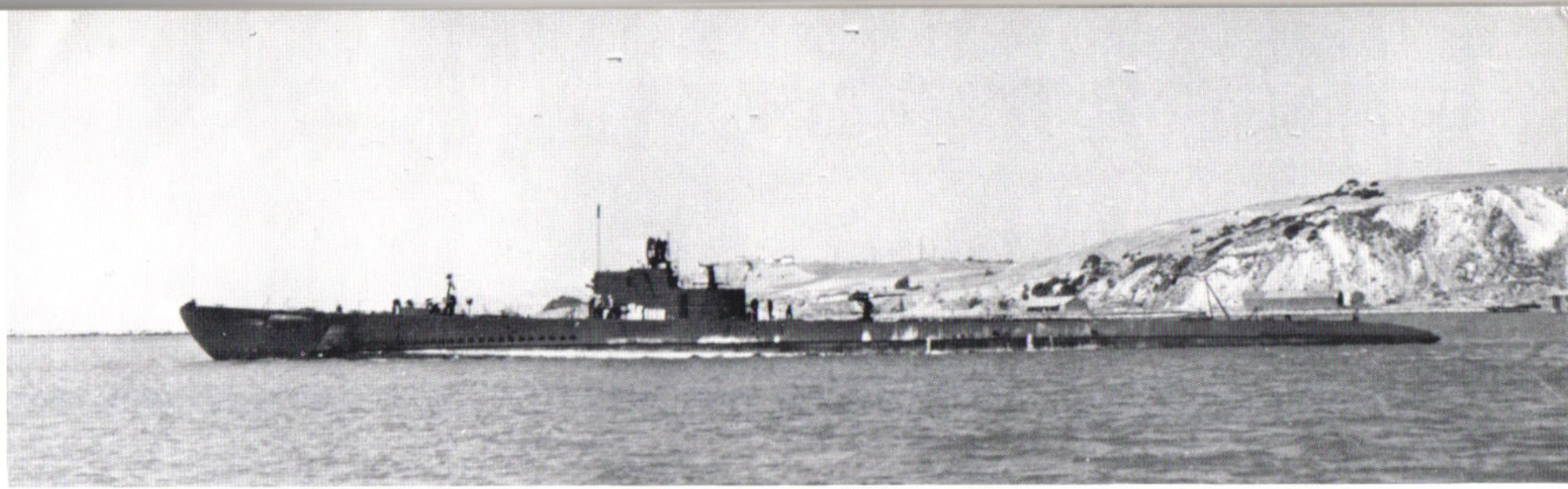
Pickerel, 1942



Tarpon **is seen before her commissioning during builder's trials, New London, 20 February 1936. Built to one of three related designs that were collectively labeled P class,** Tarpon **and her identical twin,** Shark**, differed from their classmates in having a squared-off deck casing and minor variations in the pattern of limber holes. (Electric Boat Co. via SFL)**

A squadron of P boats line up in this prewar view. The identifiable boats are: (from the left) 178-Permit**, 176-**Perch**, 172-**Porpoise**, 175-**Tarpon **and 173-**Pike**. Note the detail differences between boats, particularly in searchlight position and radio masts. The balls hanging from the extendable rod antennas were used for visual signaling. (US Navy via Dave Merriman)**

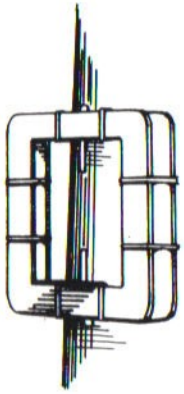


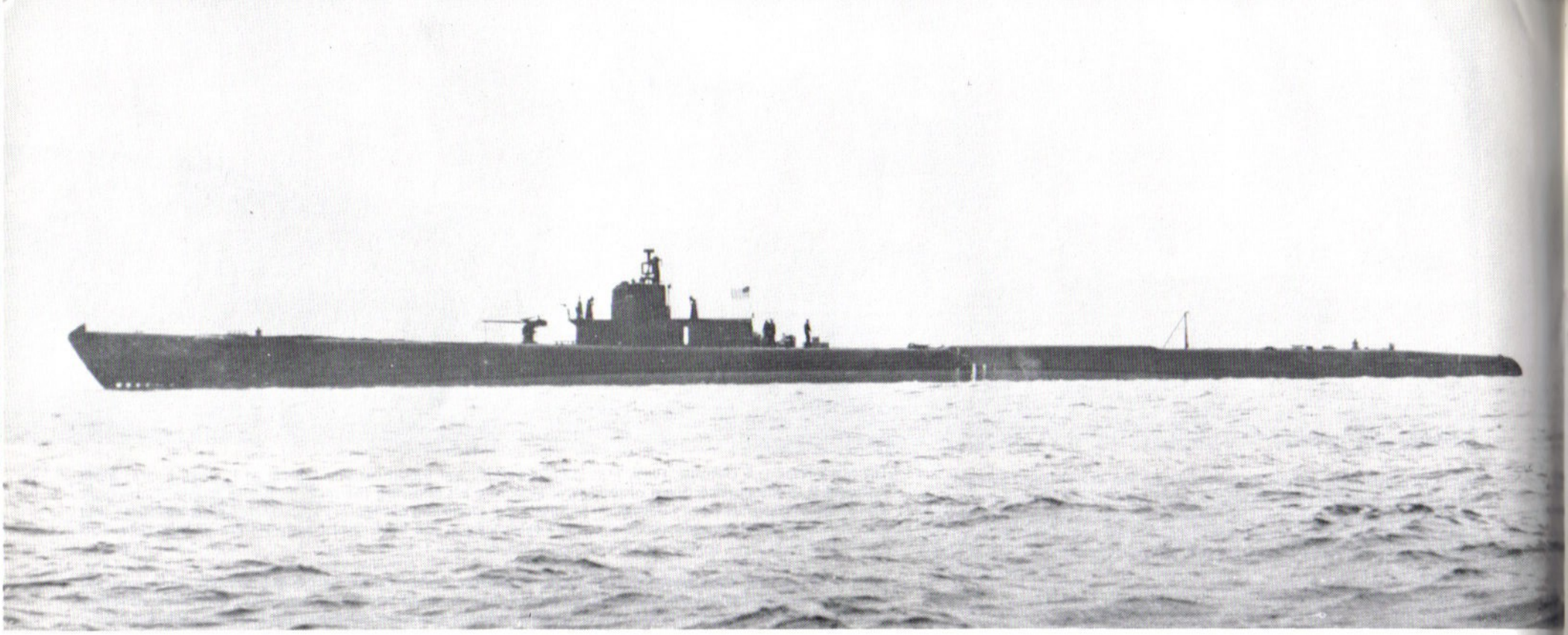


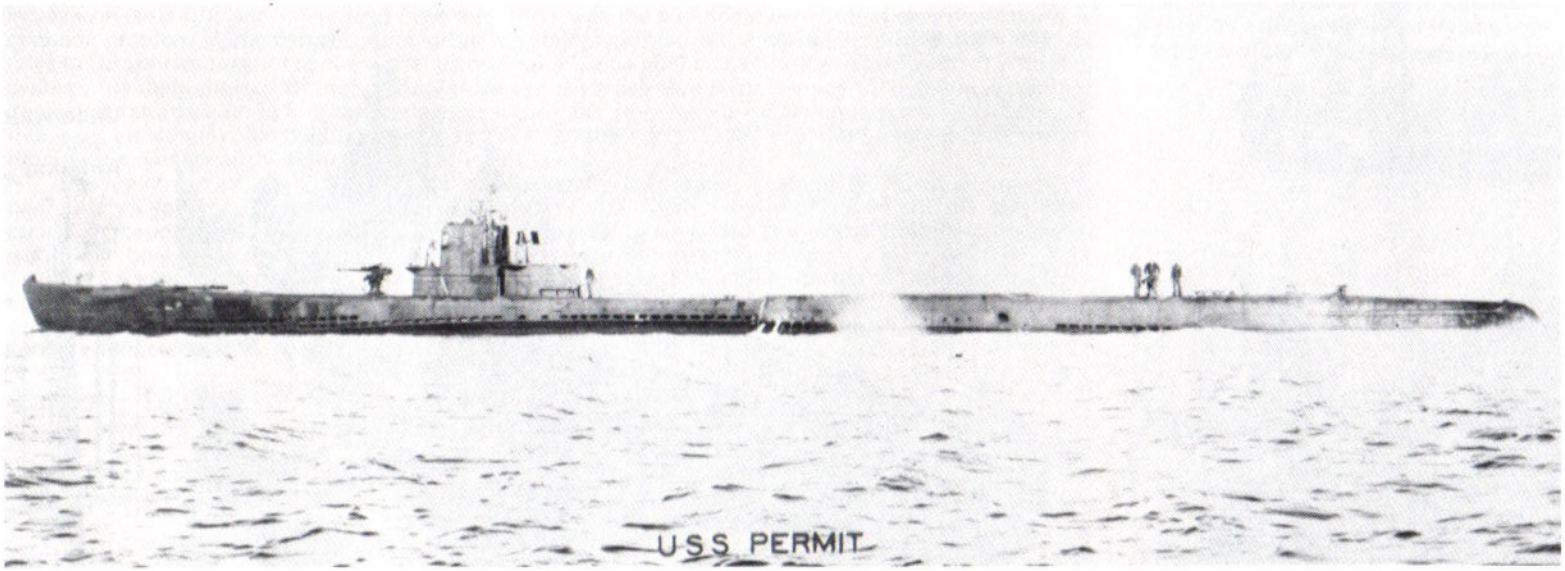
Off Mare Island, 6 October 1942, Pike **displays early war modifications typical of P class boats. Most noticeable is the cutting down of the tower structure aft allowing the mounting of a single 20mm gun. The shear plating has been removed to facilitate the mounting of radars.** Pike **was one of five P boats that had two additional torpedo tubes mounted externally at the bow, just barely visible in this view. (US Navy via SFL)**

(Left & Below) At Mare Island Naval Base, California, where most active submarines were refitted, Tarpon **shows similar modifications. Mare Island took detailed photos of each boat it refitted, circling the changes. Among the circled items visible here are the external tubes at the bow, the cut down cigarette deck and the fitting of an SD antenna toward the port of the tower, an SJ to starboard and an underwater loop antenna portside of the shears. (US Navy via Bob Cressman)**

Underwater Loop Antenna



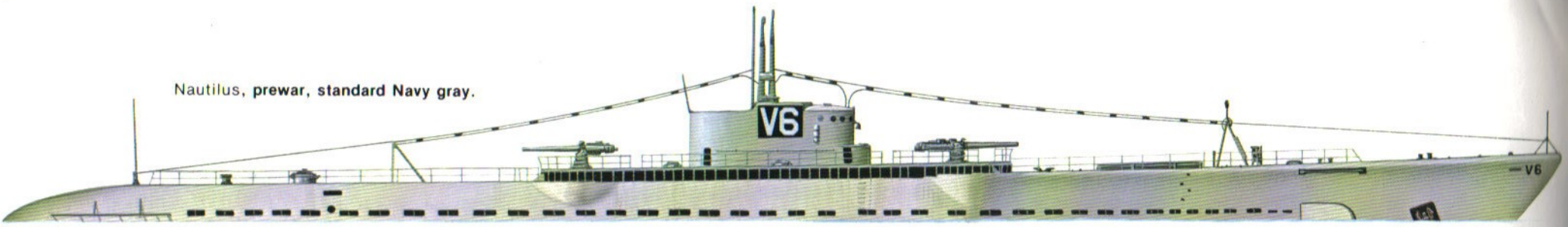




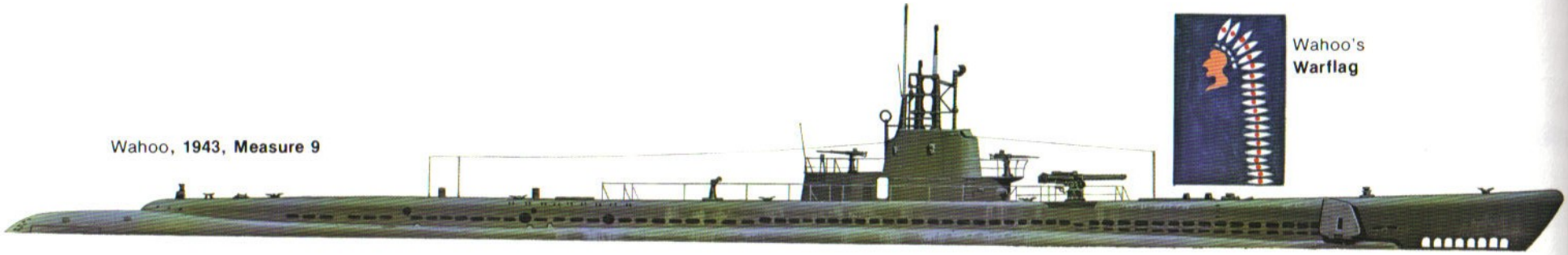
By late 1942, P boats returning for refit were having their fairwater cut down forward as well as aft and a second 20mm mount added. This photo shows Pickerel on 22 December 1942. She was lost on her seventh patrol less than four months later. (US Navy via Bob Cressman)

Permit is seen in early 1944. Soon after this the Ps began to be withdrawn from active service. Permit returned from her last patrol in November. Note the numerous extra limber holes. She appears to be painted in the rare, midwar Measure 10 overall ocean gray color scheme. (US Navy via SFL)

Nautilus, **prewar, standard Navy gray.**



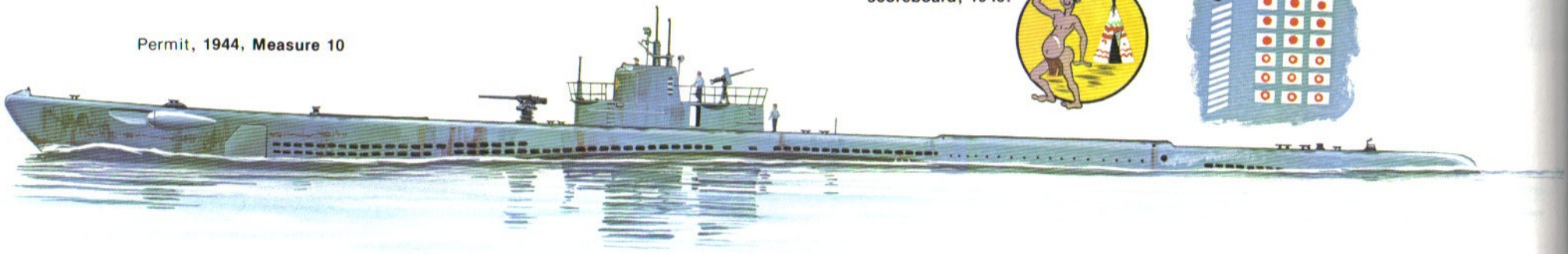
Wahoo, **1943, Measure 9**



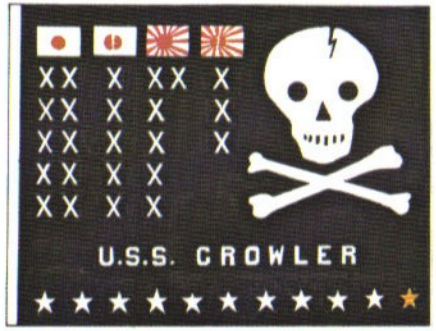
Wahoo's **Warflag**

Permit's **insignia and scoreboard, 1945.**

Permit, **1944, Measure 10**



Warflags

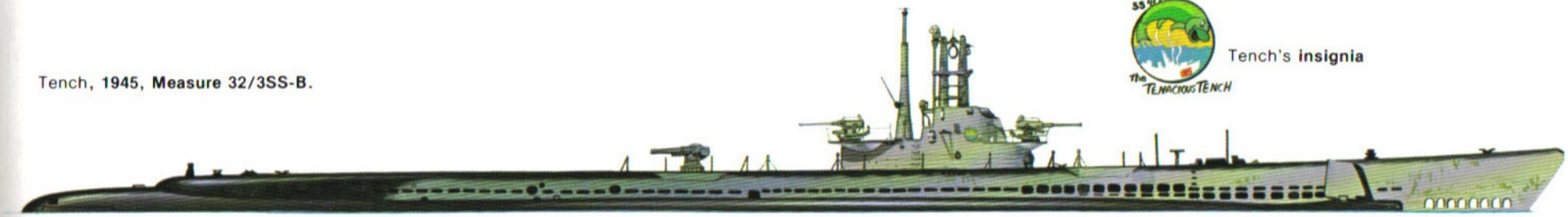


Growler, **1944**

Ray, **1945.**

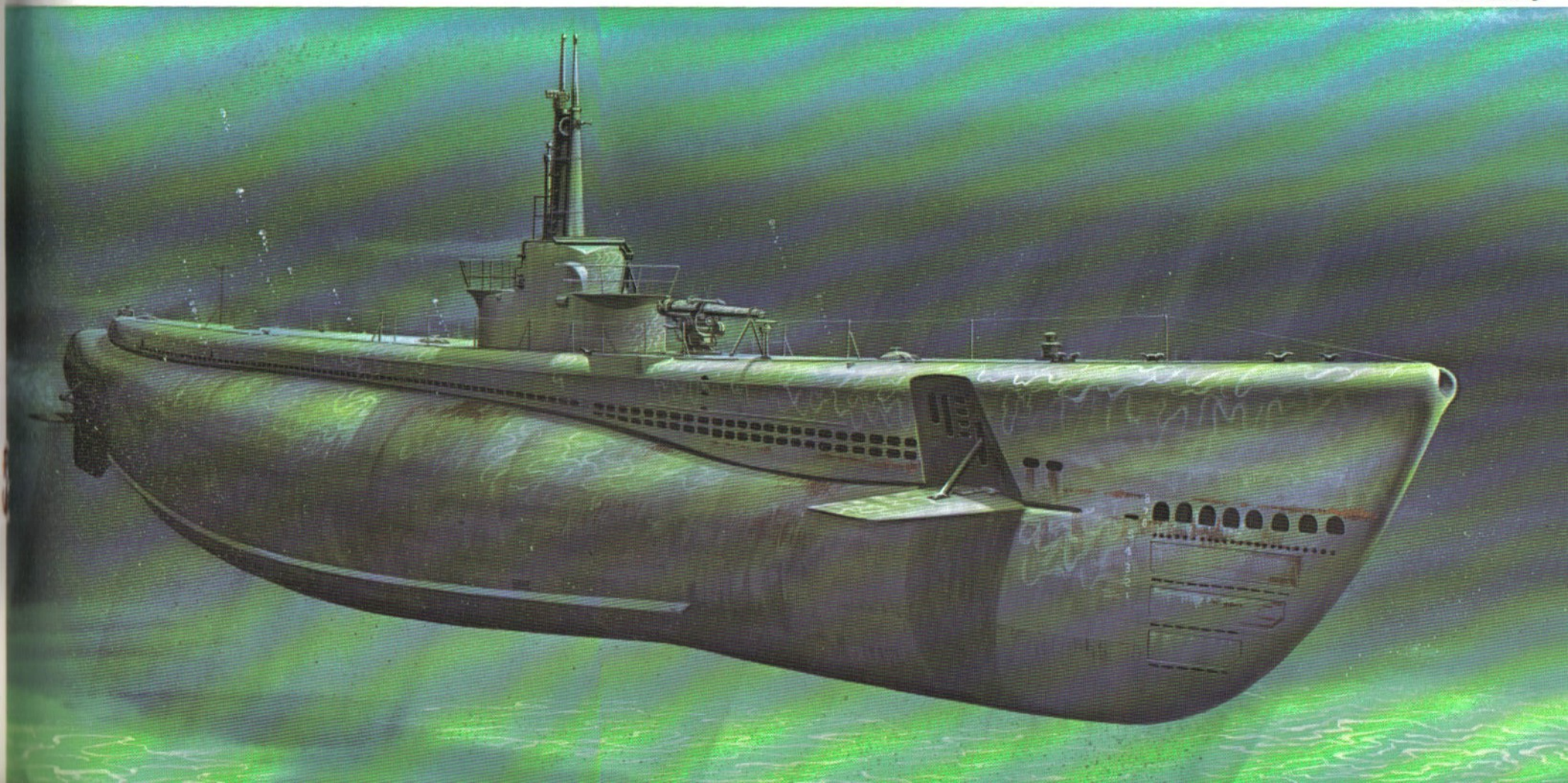
Spot, **1945**

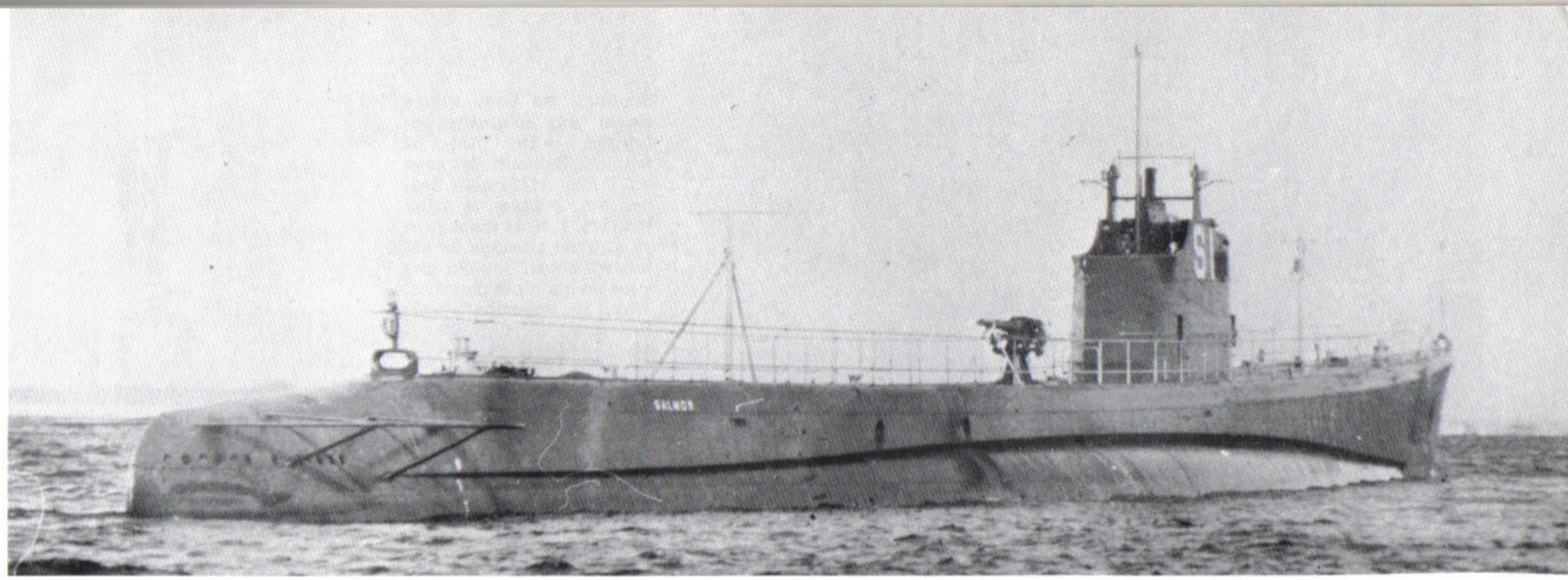
Tench, **1945, Measure 32/3SS-B.**



Tench's **insignia**

Tang, **1944, Weathered Measure 9**





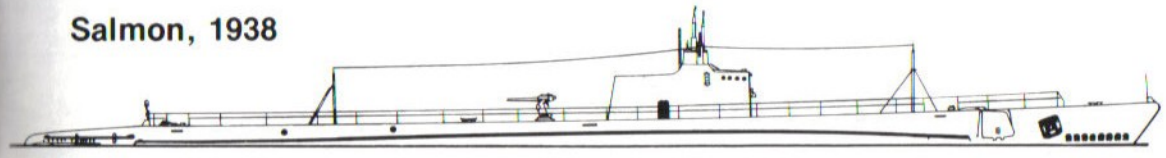
Salmon, **S1, during her builder's trials, 1938. The Salmons were a logical further development of the successful P class. (Electric Boat Co. via SFL)**

Salmon/Sargo class

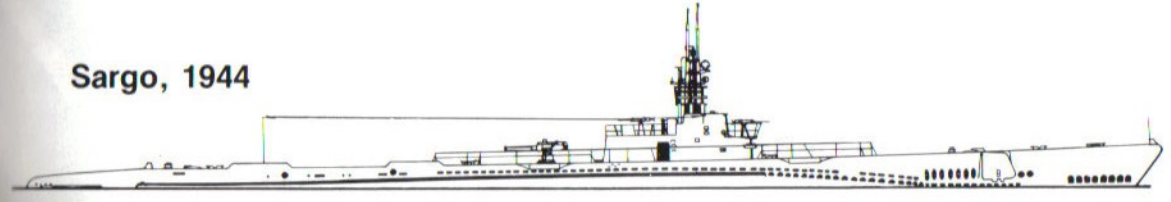
Following the success of the Ps, the Navy decided to take advantage of FDR's depression-fighting shipbuilding plans and add six Salmon boats to the fleet, to be followed immediately by 10 nearly identical Sargos. The Salmons were improved and enlarged Ps. They were longer (308ft) and bigger (1450 tons). More importantly, they were one knot faster both on the surface and submerged (20kt/9kt) and, with a doubled battery capacity, they had the endurance to navigate submerged for twice the distance (85 miles). Offensively, the Salmons carried internally the two extra torpedo tubes that were later added externally to some of the Ps, raising the total to eight. Internal torpedo stowage was increased to 24. At least one of the Salmons, **Stingray,** was fitted with two external tubes, bringing her total to the ten tubes that Lockwood and others felt were the minimum necessary.

Seemingly improved in all respects, the Salmons nevertheless suffered from one fatal design flaw. The main induction hatch, which sealed the large air intake to the diesels when the boat submerged, was poorly designed and occasionally failed to close properly. **Snapper** and **Sturgeon** had close calls due to hatch failures, but **Squalus** sank, 23 men dying. The defect was easily fixed and **Squalus** (renamed **Sailfish**) was raised, but the Salmons' reputation had been destroyed. In spite of being unpopular, they fought with distinction, four being lost. As with the Ps, most surviving Salmons conducted at least eight war patrols, **Stingray** doubling that number, being sent on more patrols than any other US submarine.

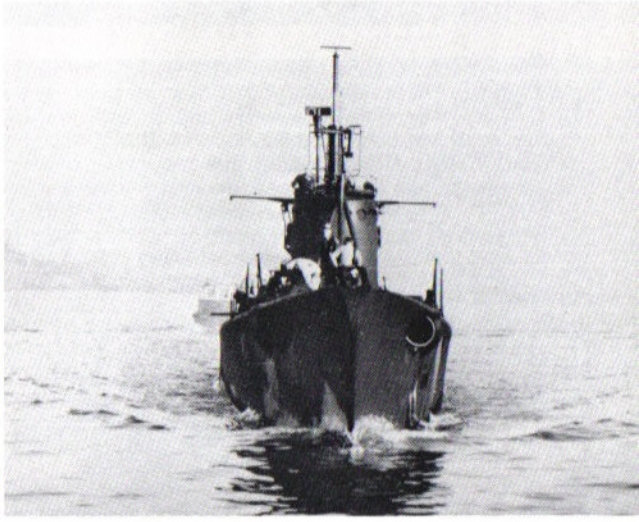
Salmon, 1938

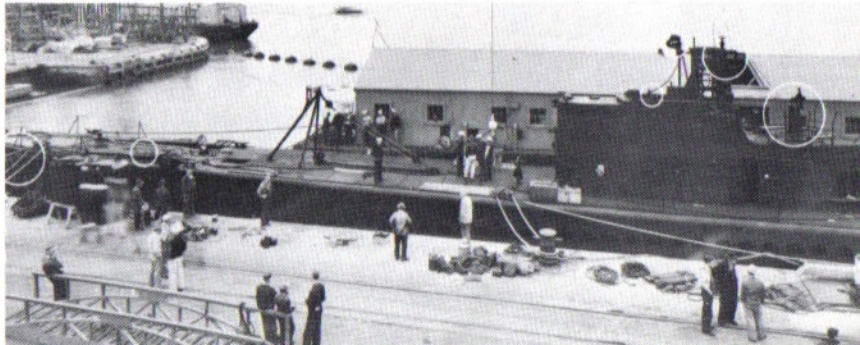


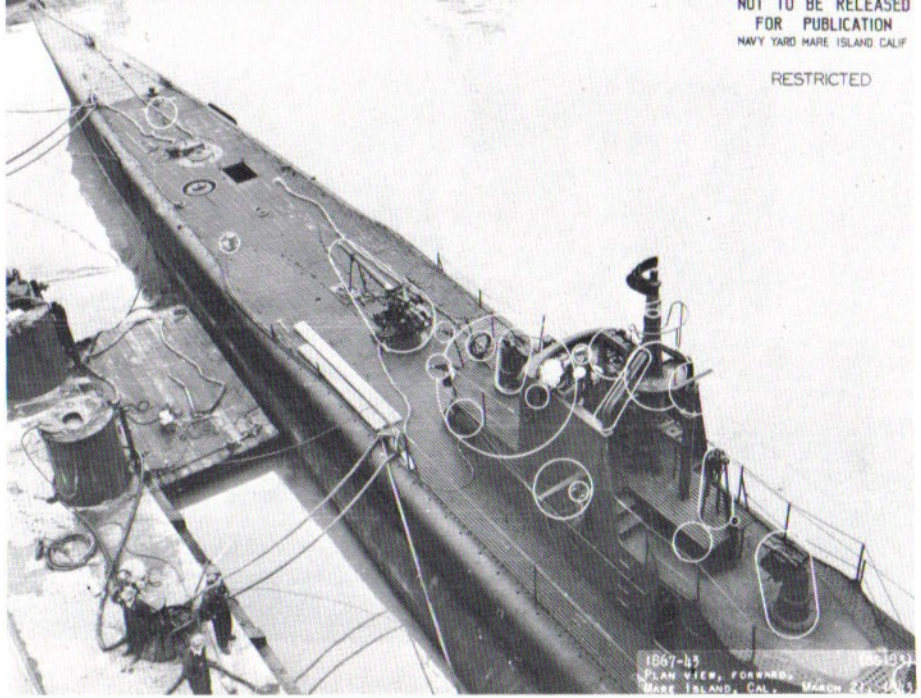
Sargo, 1944



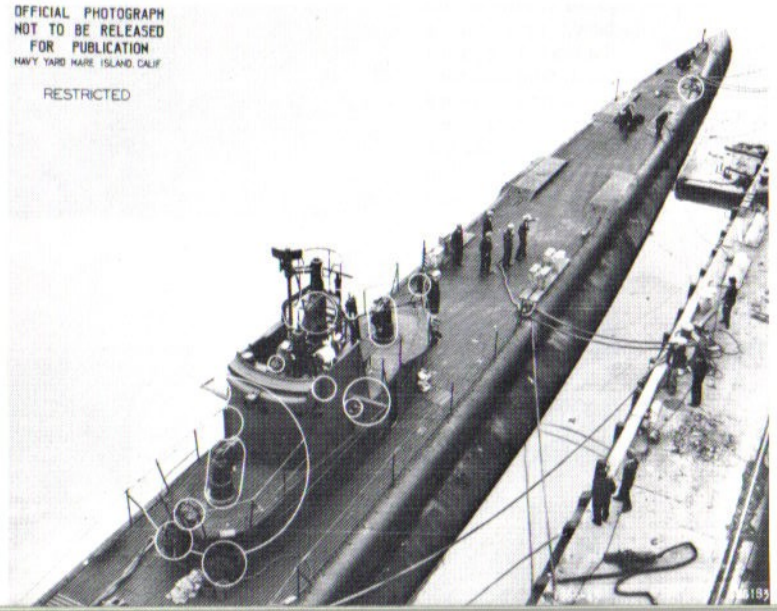
(Right & Below) Stingray shows typical 1942 modifications including cut down tower aft and added SD and SJ radars, 5 October 1942. What makes Stingray unusual is the addition of two external torpedo tubes at the bow, rare for a Salmon class boat. She went on to conduct more war patrols, 16, than any other US submarine. (US Navy via Bob Cressman)





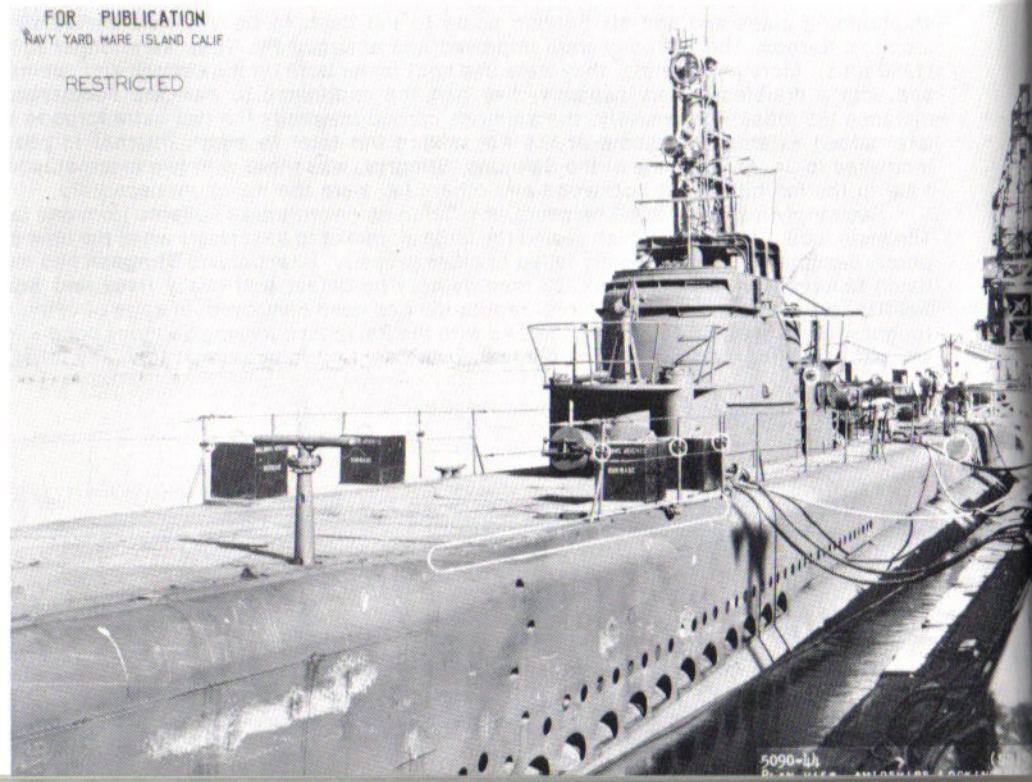


(Above & Below) Fore and aft views taken from a dockside crane show to advantage the midwar deck arrangement of a Salmon boat, in this case Seal, 21 March 1943. Seal's tower has been cut down fore and aft and positions for 20mm AA added. The 20mm Oerlikon was small and light enough that it was generally demounted and taken into the boat before diving, leaving the mount on deck as seen here. Note that only No. 2 periscope has had its shear extended, with the SJ antenna mounted to starboard and SD to the rear. Of interest is the stowage position for two long boats immediately forward of the deck gun position. US fleet boats, from the Barracudas up to early Gatos, had similar provision for small boats. (US Navy via Bob Cressman)



Sculpin, **the boat whose career was tragically entwined with that of** Squalus/Sailfish, **is seen on 1 May 1943. Like** Seal **her No. 2 shear is taller than No. 1. Note the tally of 13 claimed sinkings on her forward shear.** Sculpin **was sunk on her ninth patrol off Truk, 19 November 1943. (US Navy via Bob Cressman)**

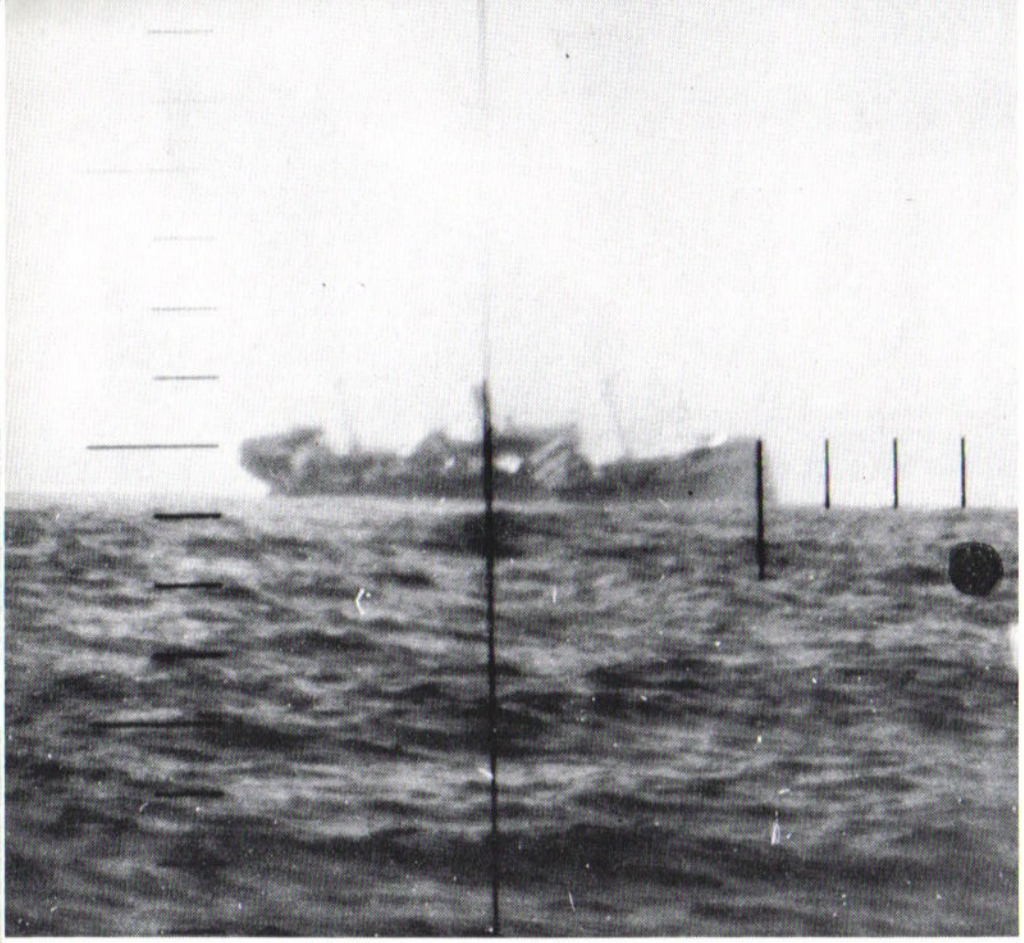
Seadragon **is seen here at Mare Island, 5 August 1944, being inclined. Each time a boat was refitted, its balance had to be recalculated by means of inclining weights, four of which are seen here. The visible modifications include the proliferation of ready-stowage containers.** Seadragon **wears a fresh measure 10 paint job, overall ocean gray. (US Navy via Bob Cressman)**



This 24 August 1944 photo shows Sargo at Pearl Harbor, displaying typical late war configuration. The 3"/50cal deck gun has been replaced by a more powerful 4"/50cal model. (National Archives)

JP Hydrophone

Salmon is seen again as she appeared on 15 February 1945, having survived a shoot-out with Japanese escorts four months earlier. After slugging it out with one of the escorts at 50 ft. range, she was able to slip into a squall and make her escape. She is seen here wearing Measure 32/3SS-B, the so-called 'light gray job'. (National Archives)



A Japanese freighter heels to starboard on her way down, before the periscope and torpedo tubes of Guardfish, **under CO Tom Klakring. This was one of four freighters** Guardfish **sank on 4 September 1942, far and away the best day for any US sub to that time. She was known as the 'race track' boat because on her first patrol Klakring took her close into the Japanese shore at a point where the charts indicated a track. When this came out at a post-patrol press conference, the first of the war, Klakring commented with tongue-in-cheek that some of his officers had placed bets on the races. The story was rapidly embellished from that point, assuring** Guardfish's **undying fame. (National Archives)**

Torpedoes

At times the torpedoes that US submarines carried to war seemed as much an enemy as the Japanese. Torpedo problems reduced the effectiveness of the Submarine Force, particularly in the first year and a half of the war. The saga of the Mk XIV torpedo and the Mk VI influence exploder has been covered at length in the Introduction. Unfortunately that was not the whole story. Other problems continued to crop up, keeping torpedoes at the top of a skipper's headache list.

Equally as frustrating as the faulty performance of the torpedoes in the early days of the war was the shortage of torpedoes altogether. Political and bureaucratic bungling had allowed the US to enter the war with a severe torpedo shortage and inadequate manufacturing facilities. The problem was of such severity that in November 1942, when only 10 patrols left Pearl Harbor, two of those boats carried only mines, there being no more torpedoes. Further, this led to great pressure being put on COs to conserve torpedoes, to limit spreads. The result was that many targets escaped because they had been inadequately covered.

Adding to this problem were the actual physical characteristics of the Mk XIV. By world standards, it was small and slow. The Mk XIV was a 21" Whitehead-type torpedo. It was a reduced copy of the World War I Mk X, capable of carrying a 500lb warhead 4500yd at 46kt, or 9000yd at 31.5kt. In comparison, the Japanese entered the war with both oxygen and electric torpedoes. The type 92 electric could carry a 660lb warhead 7660yd at 30kt, making it roughly equal in performance to the Mk XIV. The Type 95 oxygen torpedo was a 21" diminutive of the highly successful surface ship 'Long Lance'. The type 95 could propel a 900lb warhead 10,000yd at 45kt. An advantage of both Japanese torpedoes was that they left no trail of bubbles. (A Whitehead torpedo is driven by steam generated by the combustion of alcohol and water in air. The steam itself leaves no trail in the water, but the 'smoke' from the burnt alcohol does not readily dissolve in water, leaving highly visible bubbles. An oxygen torpedo is propelled by steam generated by the breakdown of hydrogen peroxide. The result of this action is pure water steam and pure oxygen ($2xH_20_2 = 2xH_20 + 0_2$). The pure oxygen dissolves readily in water, leaving no wake.)

In spite of the fact that a successful experimental oxygen torpedo had been tested by BuOrd in the '30s, fear of the unstable hydrogen peroxide fuel led to its rejection. (The Japanese used their Type 95 and 'Long Lance' torpedoes throughout the war and reported no operational accidents.) Similarly, an electric had been tested between the wars but was rejected as being too expensive to develop. In 1941 BuOrd changed its mind and let contracts for electric torpedo development. By Spring 1942, no significant progress having been made, BuOrd took some German G7e duds that had run up on American beaches and turned them over to Westinghouse with orders to produce a quick, cheap copy. By June the Mk XVIII entered testing, but the gestation was to prove long and difficult. Westinghouse had never produced torpedoes before and American battery technology had lagged behind Germany's. Fall 1943 had arrived before Mk XVIIIs were delivered to the fleet and it was well into 1944 before they were reliable enough to be useful. Only after July 1944, when the Mk XVIII had been debugged and was available in sufficient quantity, did its use become widespread. Thereafter, US subs carried a mix of 75% electrics, 25% steam.

In late 1944 a new short acoustic torpedo based on the German T4 Zaunkonig arrived at Pearl Harbor. Called the 'Cutie', this wondrous device suffered numerous bugs and proved incapable of hitting a target moving faster than 8½ kt. A series of combat tests proved it to be too unreliable for use from subs. It did have more success as an air-dropped anti-submarine weapon in the Atlantic.

Both the Mk XIV and Mk XVIII suffered from an additional serious problem, the relatively small size of their warheads. At 500lb, the warheads of US torpedoes were smaller than those used by any other nation. Particularly when used against tankers, a high priority target from late 1943 on, the small size of this warhead was a distinct disadvantage. In October 1943 this was proved beyond any doubt. At that time **Steelhead** and **Tinosa** together put 20 torpedoes into the 10,000GRT tanker *Kazahaya* before she finally sank.

Finally, guidance problems would continue to trouble and endanger US submarines long after all other problems with the Mk XIV and Mk XVIII had been solved. At least two subs (**Tullibee** and **Tang**) are known to have been sunk by their own torpedoes which had made a circular run. A number of others by sheer luck or great skill barely missed the same fate. Truthfully one can say that it was in spite of, rather than because of, the quality of the weapons with which US submarines were armed that they achieved their great success.

Two of the new Tambors are seen soon after commissioning, showing the noticeable differences between the Government and Electric Boat designs. Triton, **to the left, was built to the Government design.** Tautog, **below, was built by Electric Boat Co., differing in the arrangement of limber holes. The dozen Tambors were built to no fewer than four distinct designs. In the view below,** Tautog **is drawn up dockside, along with** S38 **and another unidentified sub, for a Presidential inspection by FDR, 1940. (US Navy via SFL)**

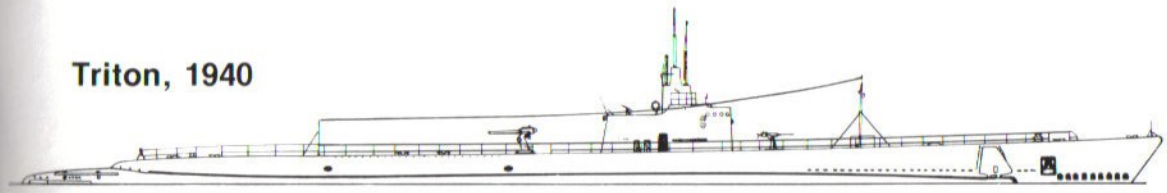
Tambor class

The Ts were the next logical step in US submarine development. The 12 Tambors improved the hitting power (10 torpedo tubes) while maintaining the other features of the Salmons. As such they represented the boat for which the Submarine Force had been waiting. They were long-legged enough to reach Japanese waters and powerful enough to do some damage while there. A considerable faction of the surface fleet felt that subs were getting too complicated with their TDCs and too fancy with their air conditioning. As a sop to these voices, the Submarine Force was compelled to agree to a reduced number of Tambors and to the construction of the two unsuccessful, diminutive Ms. The Navy was later to bitterly regret this decision which reduced the number of fleet boats available in December 1941.

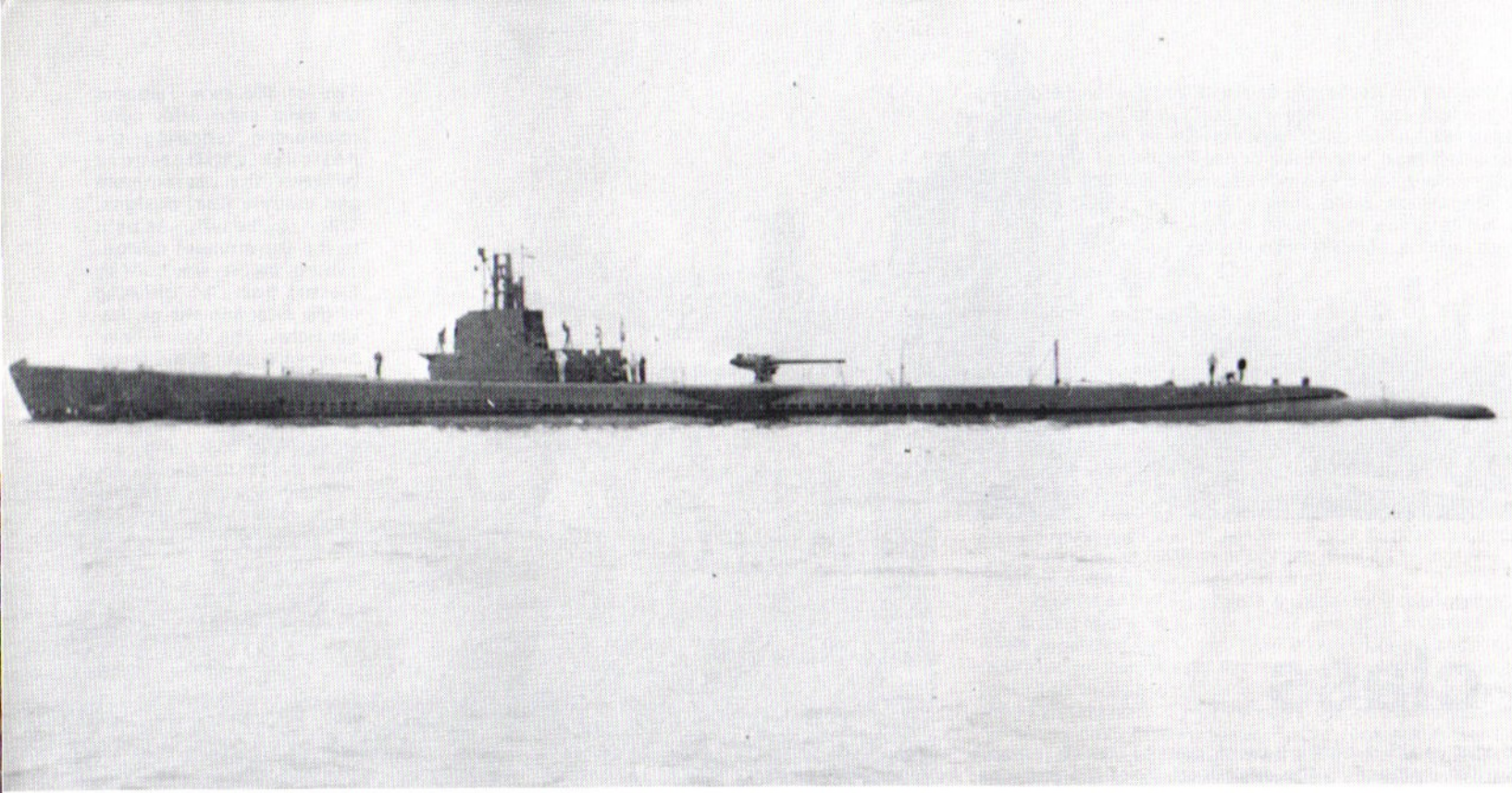
The Tambors were the last boats commissioned before the outbreak of war. They carried the brunt of the fighting until Gato class boats began to arrive in significant quantities in late 1942. They then soldiered on until being sent to well-deserved retirement in late 1944. The Ts paid a price, losing seven, more than half of their number, to enemy action. Those that survived included **Tautog**, the leading submarine in terms of enemy ships sunk.

Pulling into Dutch Harbor in May 1942 before her fourth patrol, Triton **appears to be in 'as built' condition except for the addition of extra limber holes to reduce diving time. The Tambors were excellent boats, the best the Navy had until the Gatos arrived in quantity later that year.** Triton **was lost on her sixth patrol, 15 March 1943. (US Navy via SFL)**

Triton, 1940

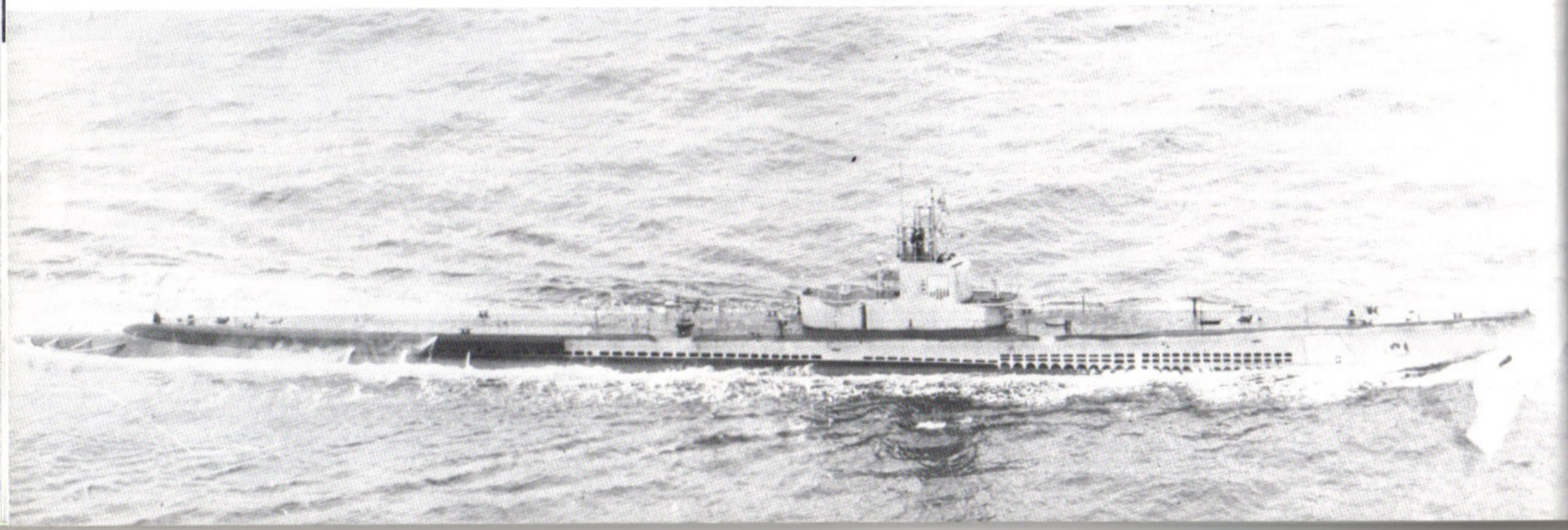


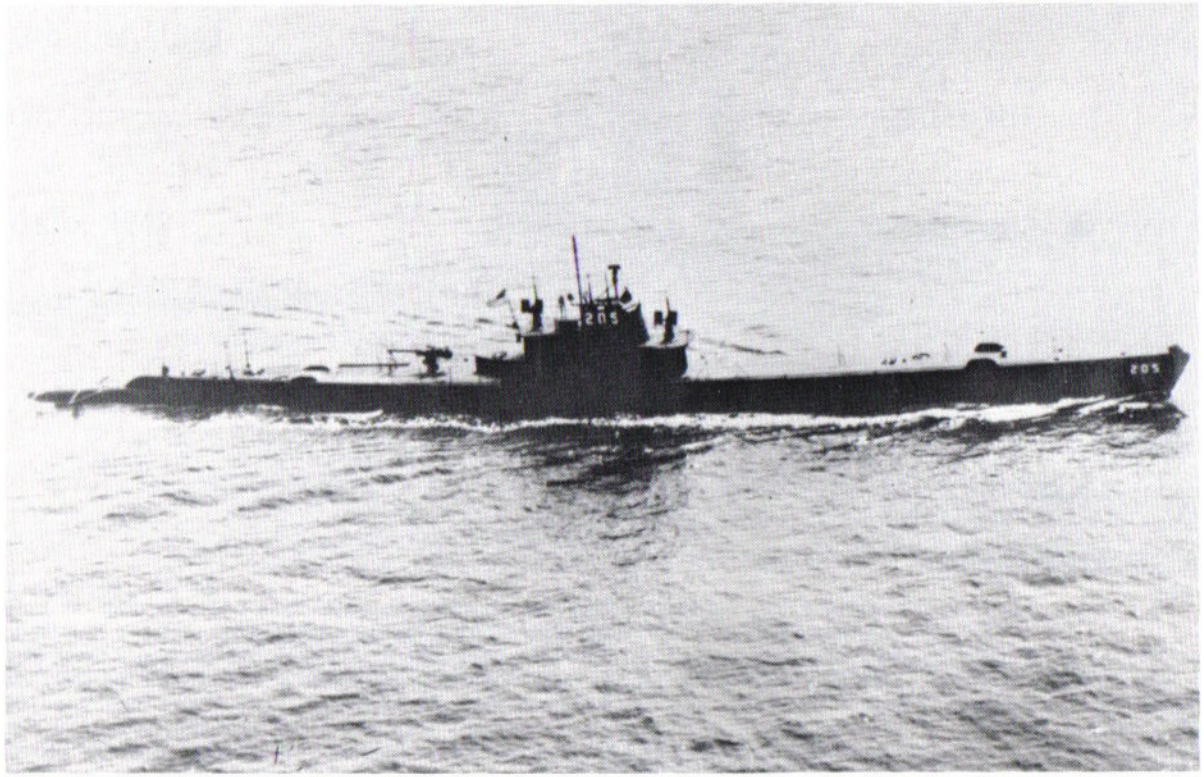
Gar, 1944



Seen in December 1943, Trout shows the results of a refit at the Hunter's Point yard. Her tower has been cut down fore and aft, radars added or updated and a 4" gun mounted aft. After returning to combat in February, Trout encountered a convoy of four troop transports escorted by three experienced destroyers. She got one of the transports, the destroyers got Trout, 25 February 1944. (US Navy via SFL)

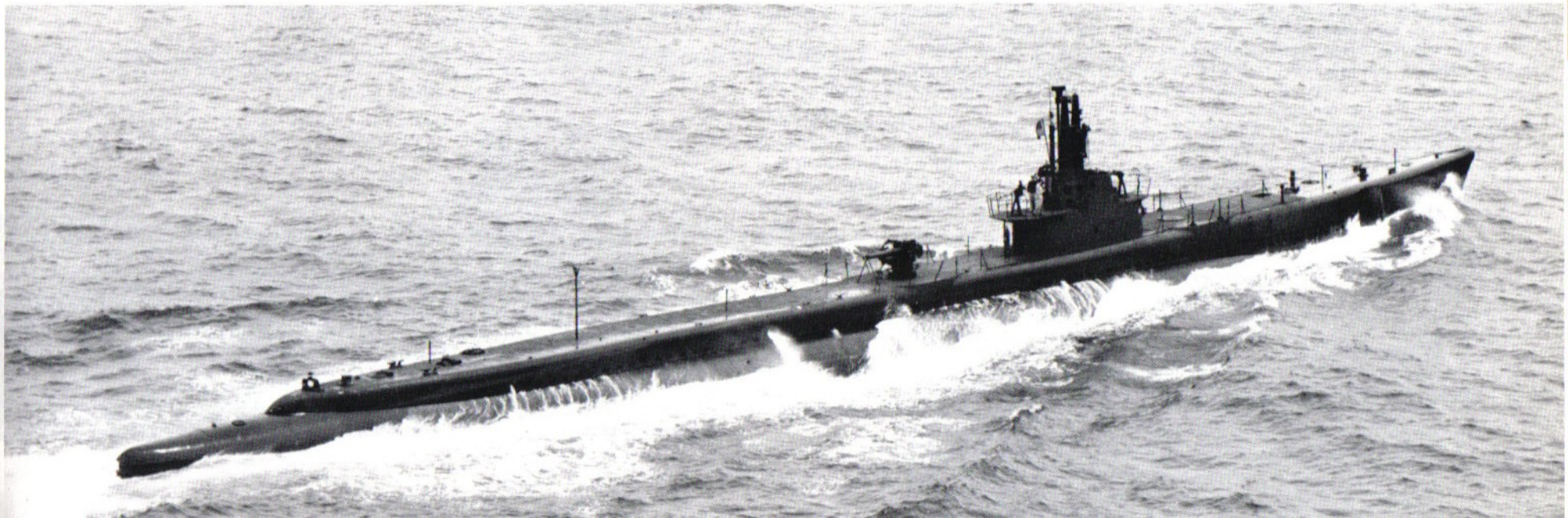
The most successful boat of the war, in number of enemy ships sunk (she got 26), Tautog was in the thick of it from the outbreak of war until retirement after 13 patrols in January 1945. At Pearl Harbor on 7 December 1941 she drew first blood for US subs by shooting down a Japanese plane. In retirement she proudly wears her war record on her fairwater. (US Navy via SFL)

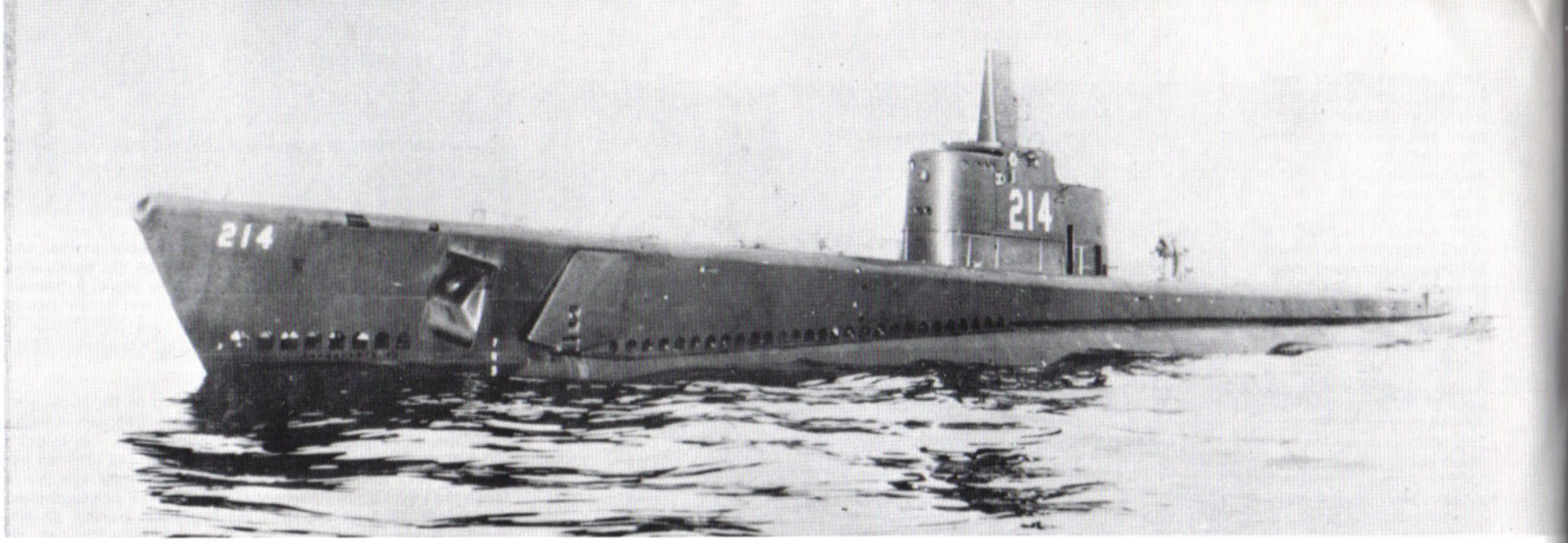




(Left) Inserted into the middle of the Tambor series, two further diminutives, the Ms, were forced on the Submarine Force by surface fleet admirals. They were extremely unpopular with the Submarine Force which was committed to its fleet boats. Marlin, seen here midwar, was used briefly in the Atlantic and then relegated to training duties. (US Navy via SFL)

(Above & Below) Two of the second group of Ts, Grayback, above, and Gar show typical latewar form. Grayback appears after refit, on 26 August 1943, now mounting two 20mm guns and a 4" deck gun aft. She was lost four months later on her tenth patrol, having been caught on the surface by a Japanese aircraft, 26 February 1944. Gar was photographed on 31 May 1944 as she was leaving Pearl Harbor on her twelfth patrol. Note that the fairwater beneath the aft cigarette deck has been cut away and braced in a further attempt to reduce diving time. While unusual in a T boat, this modification was more common among Gatos. Some late Balaos and all Tenches were launched with this configuration. Gar also mounts a 5"/25cal gun aft. This fired a large, slow shell that finally satisfied demands for a gun with enough punch to finish off small targets quickly. (US Navy via SFL, National Archives)





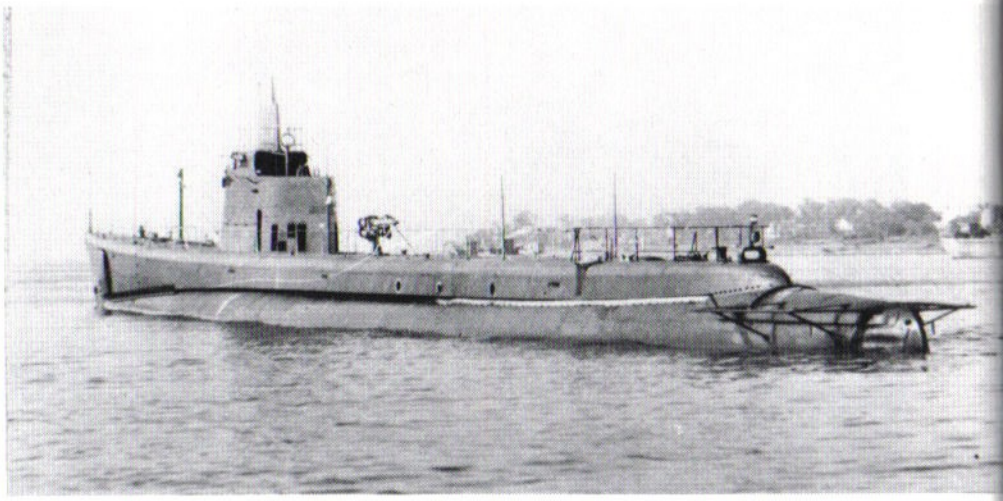
Gato class

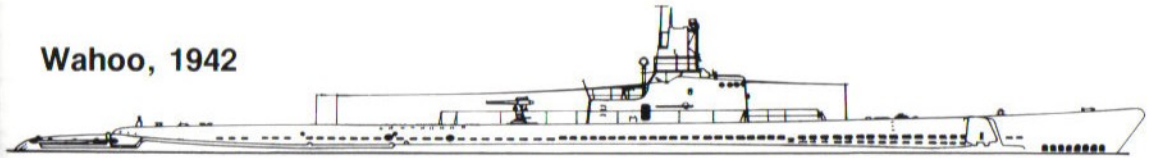
The first Gato class boat was **Drum**, which was commissioned on 1 November 1941, the only Gato to be in service at the time of the attack on Pearl Harbor. She was the first of 73 Gatos ordered in 1940 in response to the realization that the US would probably become involved in the current war. After Pearl Harbor 132 additional boats of the nearly identical Balao class were ordered. The Tench boats of 1944 were considered by some to be a separate class, but except for some internal rearrangements were virtually indistinguishable from the Balaos. 134 Tenches were ordered

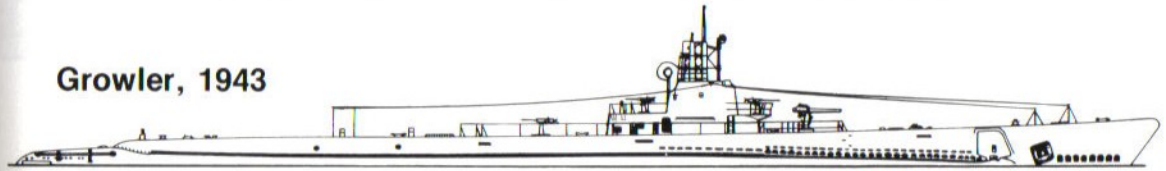
The Gatos were enlarged versions of the penultimate Tambors. They were 350 tons heavier (1825 tons) and four feet longer (312 ft), most of the additional weight being taken up by improved diesels and batteries giving improved performance and endurance. The remainder of the changes had to do with habitability (increased fresh water bunkerage, etc.). The Balaos were identical except that they were slightly redesigned internally to facilitate prefabrication and their pressure hulls were constructed of a higher tensile strength steel allowing dives of an additional 100ft to a maximum of 400ft. These boats were extremely popular, proving their toughness time and time again. The Tenches varied somewhat in internal layout, otherwise being identical to the previous boats.

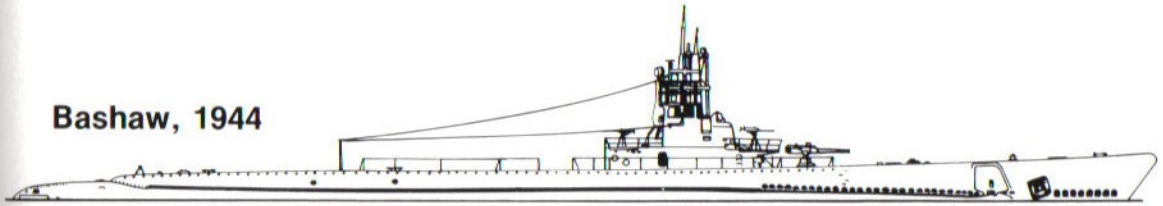
The Gatos carried the burden of the submarine war from late 1942 until victory. Of the 73 boats ordered, one (**Dorado**) was lost in the Atlantic. Of the remaining Gatos, 18 were lost in action against the enemy. The vast majority of boats whose names became famous during the war were Gatos. **Flasher** (the leading boat in terms of tonnage sunk), **Barb, Growler, Silversides, Trigger, Wahoo** and **Harder**, along with many others nearly as famous, were all Gatos. Of the 132 Balaos ordered, 10 were canceled on the way and 21 arrived too late to make war patrols, leaving 101 which saw action against the Japanese. 10 of that number were lost. Most arrived too late to make many patrols or gain much fame, Cutter's **Seahorse** and O'Kane's **Tang** being notable exceptions. 134 Tenches were ordered, but only 30 were actually completed and of those only 11 arrived in time to make war patrols. None were lost to enemy action.

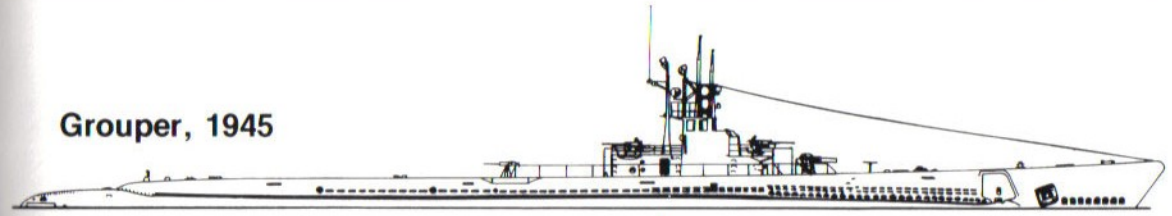
From the bow and stern, these two views show Gato class boats in their 'as built' configuration. Grouper **is seen above during builder's trials. Note that she is missing her anchor. She still carries her hull number despite the fact that this photo dates from after Pearl Harbor, 24 January 1942. Viewed from the stern,** Barb **wears the early war overall dull black scheme, 20 June 1942. As launched, early Gatos resembled the previous Tambors in general arrangement despite the fact that they were 350 tons bigger. Both** Grouper **and** Barb **were built to the Electric Boat Co. design which differed from the Government design most noticeably in the arrangement of limber holes. Government boats had a line of oval limber holes along the full length of the hull. (Electric Boat Co. via SFL)**

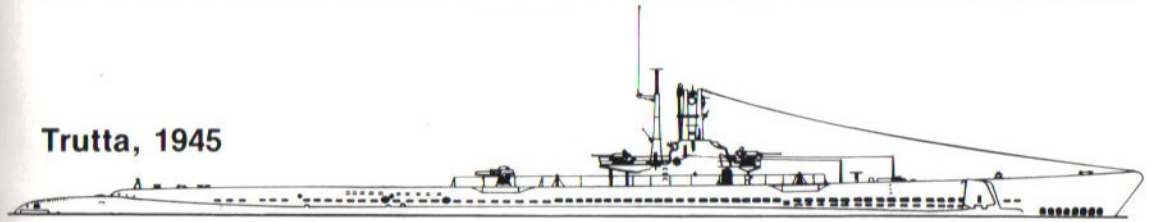






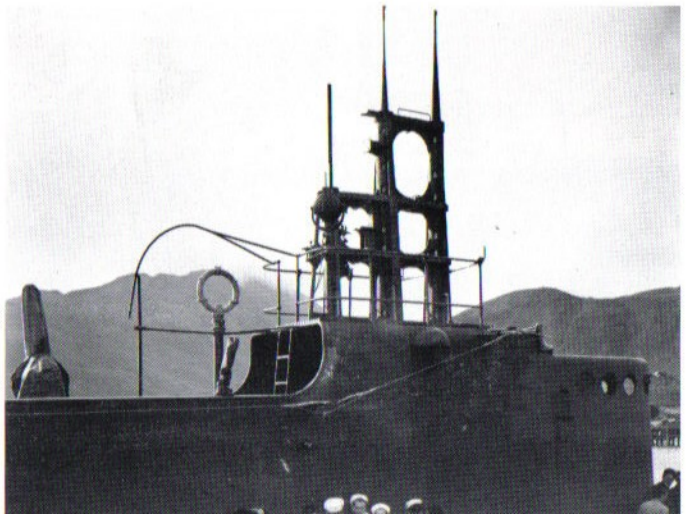


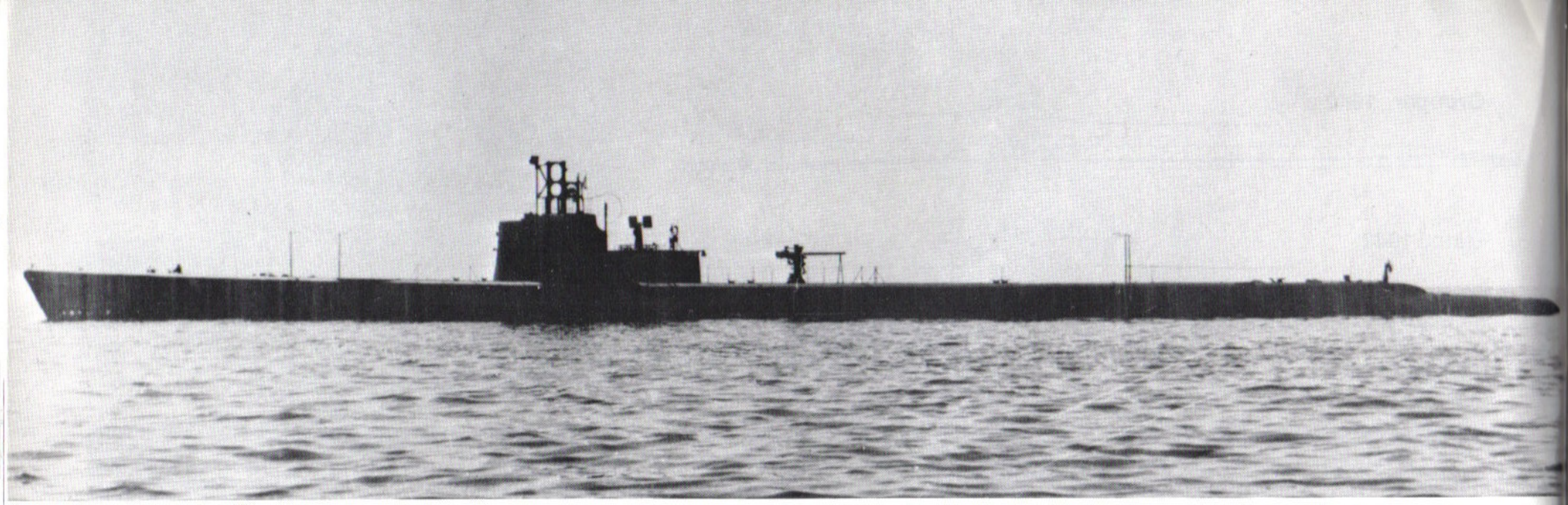


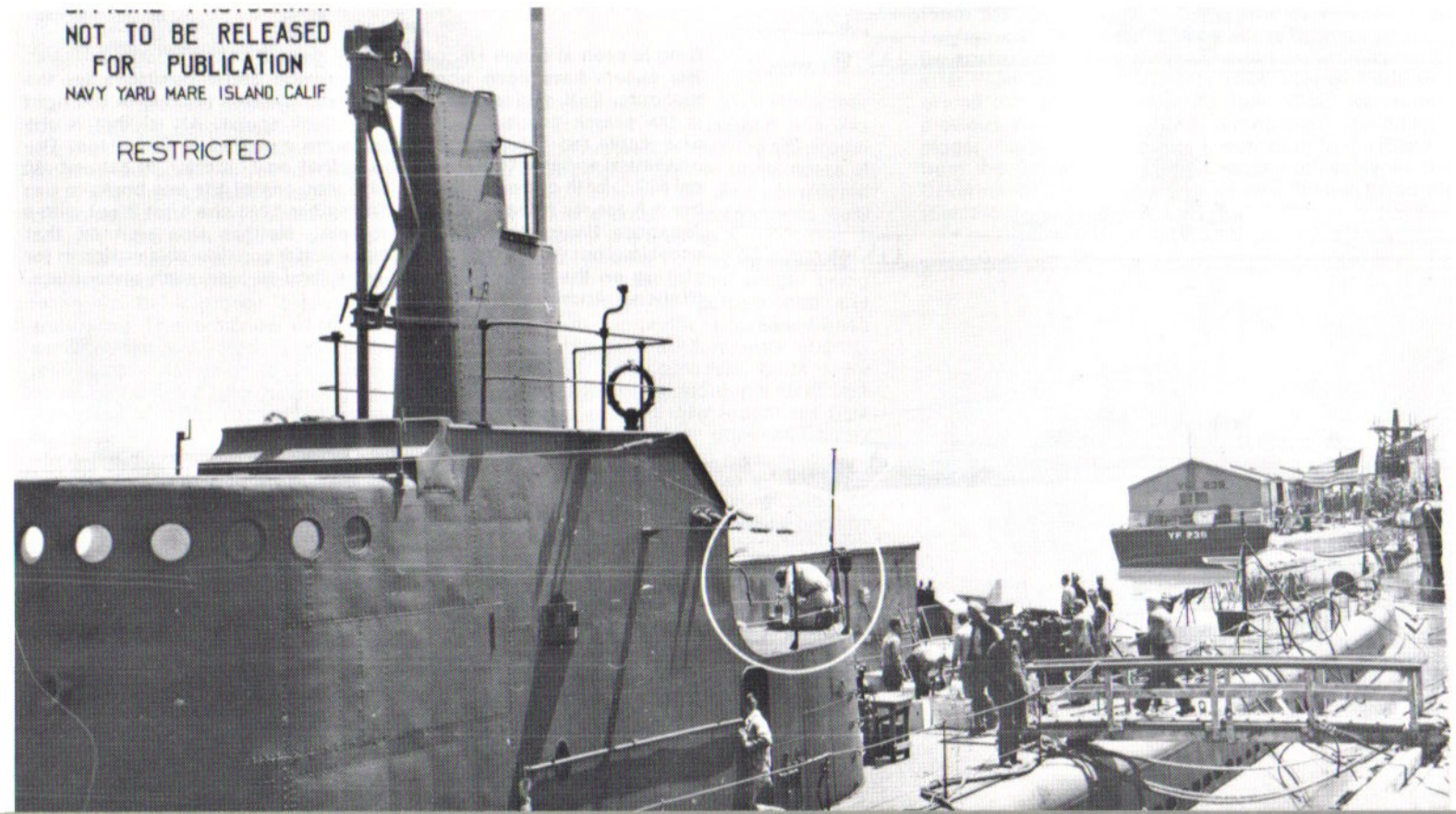


The crew of Finback poses in front of and on her fairwater at Dutch Harbor after her first patrol, 1 August 1942. She has a water-cooled .50 cal MG mounted on her cigarette deck and two .30 cal Lewis guns mounted at the lookout positions. Note also the canvas-covered .50 cal MG in front of the shears. The semi-circular wire brace aft of the shears protects the DF loop. (US Navy via SFL)

Gato is seen at Dutch Harbor after her second patrol, 30 August 1942. Her shears have been unplated to provide better positions for the lookouts. Both periscopes are extended. The No. 1 scope to the right is the search scope. No. 2 is the attack scope. Aft of that is the extendable rod antenna. No radars were mounted at this stage. The armament appears to be the same as that on Finback, .30 cal and .50 cal MGs, both canvas-covered. Gato was one of the few boats to use her AA for its intended use. In December 1943 she shot it out with a Japanese floatplane in the Solomons. Neither side won on that occasion, but Gato's CO, Foley, came under considerable criticism for staying on the surface because subs tend to lose such encounters. (National Archives)

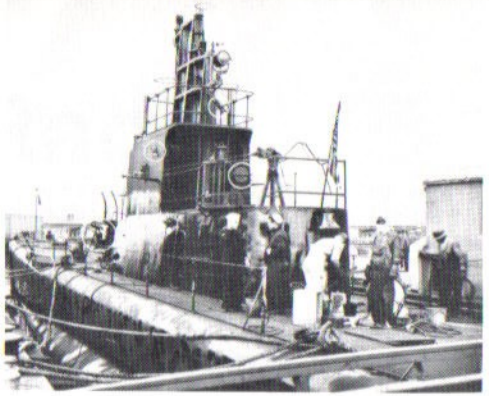






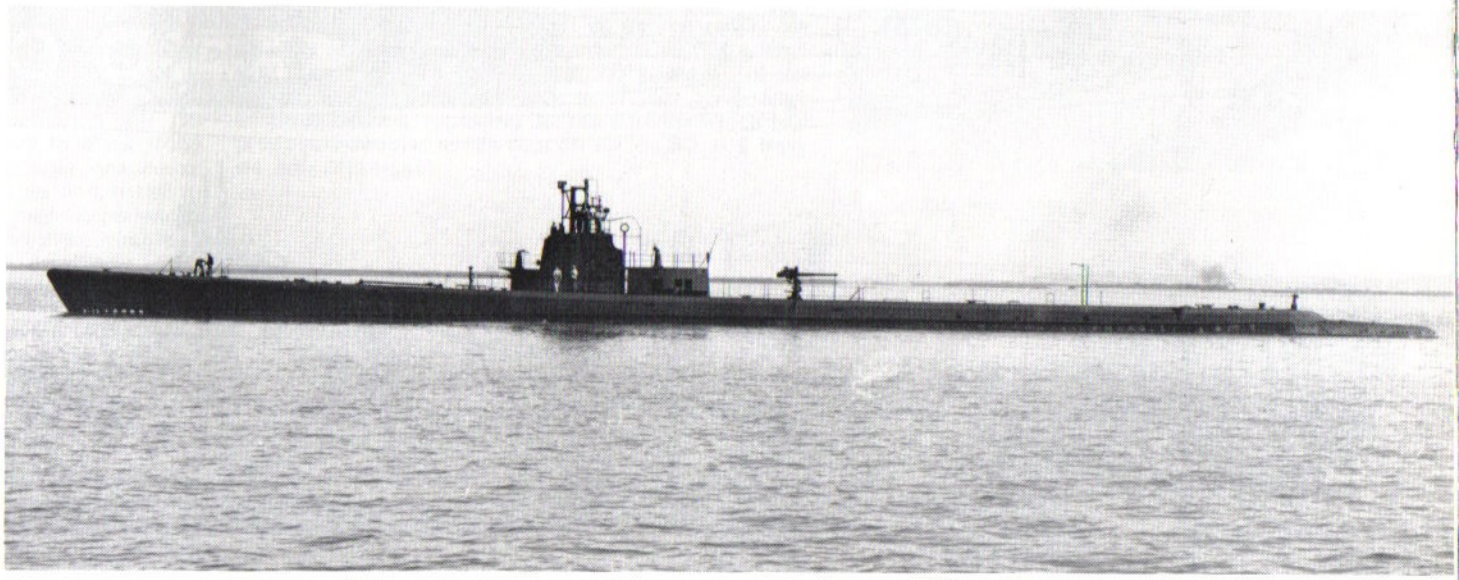
Kingfish **shows early war modifications to the Gatos in this late 1942 photo. SJ and SD radars have been added, the tower has been cut down aft and a shielded 20mm mount added. (US Navy via SFL)**

Wahoo **at Mare Island, 10 August 1942, shows the standard radars (the SD has been mounted but is extended beyond the picture area), and the cut-down tower normal for this time.** Wahoo **is unusual in that her shears have remained plated. Note the lookout position created aft of No. 2 scope. (US Navy via Bob Cressman)**



This 30 November 1943 photo shows Hake being repainted at Mare Island. A mottle of gloss black is being added over the base coat of dull black. It is impossible to ascertain whether this was intended as camouflage, an interesting possibility. (US Navy via Bob Cressman)

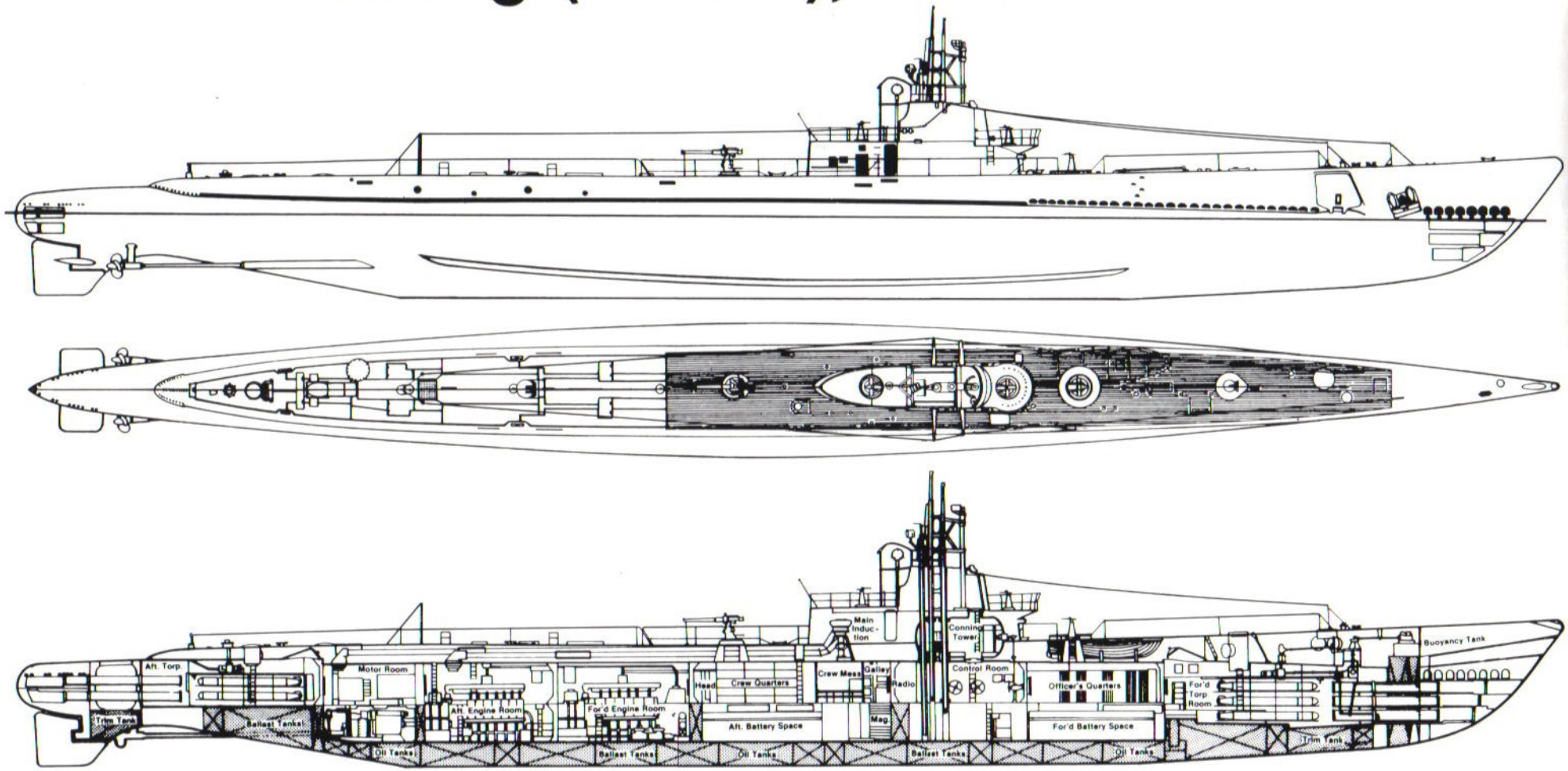
This excellent view shows Growler on 5 May 1943. Now repaired after her famous scrape with a Japanese freighter, she has had her fairwater cut down forward and a second 20mm added. The deck gun has been moved forward and a third 20mm mount added on the deck aft. Note the extra limber holes forward of the bridge. (National Archives)



The second Gato, Greenling, shows the portside of a typical midwar boat, 17 May 1943. Not having been damaged, her modifications were not as extensive as those done to Growler. (National Archives)

A later production boat, Hoe, which was commissioned in December 1942, is seen while working up at Pearl Harbor, 10 February 1943. Gaining from experience with the early Gatos, Hoe was built with the modified tower form and extra limber holes. Hoe was involved with Flounder in the only war time collision between US subs. Fortunately neither boat was lost. (National Archives)

USS Greenling (SS213), 1943



BUILDER: ELECTRIC BOAT CO., GROTON, CONNECTICUT
AUTHORIZED - 17 MAY 1938
LAID DOWN - 12 NOVEMBER 1940
LAUNCHED - 20 SEPTEMBER 1941
COMMISSIONED - 21 JANUARY 1942

DIMENSIONS: LENGTH - 311' 9" OA
BEAM - 27' 3"
DRAFT - 15' 3" AT SURFACE TRIM

DISPLACEMENT: SURFACE - 1526 ton
SUBMERGED - 2424 ton

ARMAMENT: GUNS - 1 3"/50 CAL., 3 20 mm
TUBES - 10 21"/6 BOW, 4 STERN, 24 TORPEDOES CARRIED

MACHINERY: ENGINES - 4-GM/5400 BHP
MOTORS - 2-GE/2740 SHP
BATTERIES - EXIDE/252 CELLS

SPEED: SURFACE - 20.25 Kt
SUBMERGED - 8.75 Kt

COMPLEMENT: OFFICER - 6
ENLISTED - 54

DESIGNED OPERATING DEPTH: 300'

Radar

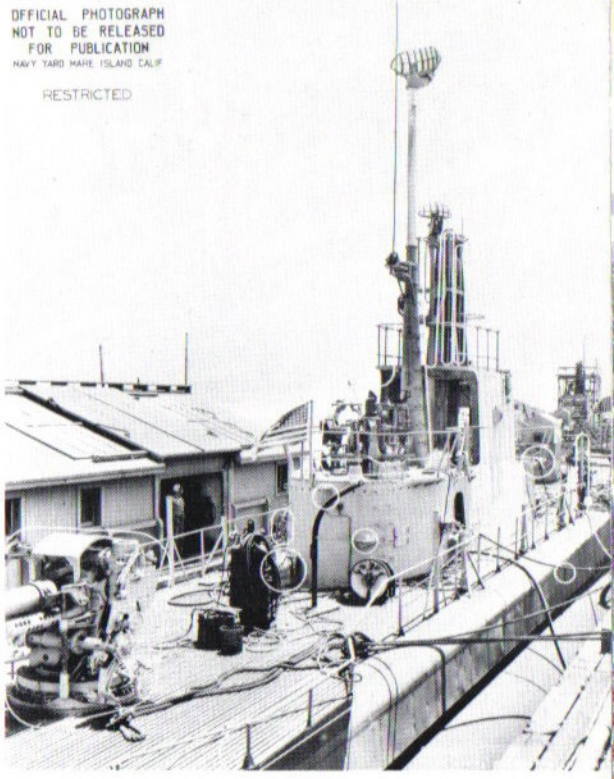
While other navies experimented with aircraft to extend the observational limits of submarines, the US Navy took a completely different tack, one that ultimately proved much more successful. Since the early 1930s the Naval Research Laboratory, with the sometimes begrudging cooperation of their Royal Navy counterparts, had been working on equipment that would direct radio waves against a target and receive the reflected signals. This technique was called 'Radio Detecting and Ranging', shortened to 'Radar'. By late 1938 the first experimental set was ready to be installed on the battleship New York. It was bulky and unreliable, but it worked. Progress was rapid. By May 1940 a new, smaller and more reliable set was being fitted to US capital ships.

Submarines had to wait a while longer. Nevertheless by late 1941 an air-search set that was small enough to fit into a submarine was available. This first set, the SD, was a non-directional radar of six to ten mile range which gave off powerful radiations that could be tracked by enemy RDF. Still, it was a tremendous aid in detecting aircraft, perhaps a sub's greatest nemesis. **Plunger** left Pearl Harbor on 13 December 1941 with one of the first sets, the first US submarine to carry radar into action. As rapidly as possible all other subs were fitted with SD sets.

In July 1942 **Haddock** carried the first of the next-generation radars, the SJ surface-search set. This gave the submarine both the range and bearing of a target of sufficient accuracy to allow firing solutions based on SJ data alone with a reasonable chance of success. While the first sets were notably unreliable and tricky to calibrate, as the sets got better and the operators more experienced submariners found that they could rely on the SJ to tell them what their eyes could not.

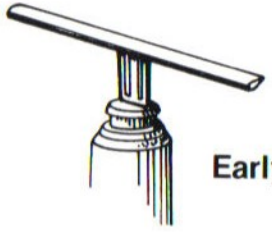
In September 1943 **Snook** carried the first of a new type radarscope that showed target information graphically with the sub displayed at the center of a circular screen and reflections appearing in the space around the center in relation to their true range and bearing. This new scope, called PPI (Plan Position Indicator), replaced the older model which showed target information as peaks in a horizontal line. The graphic presentation of the PPI took the radar image out of the realm of the arcane, making it understandable to all.

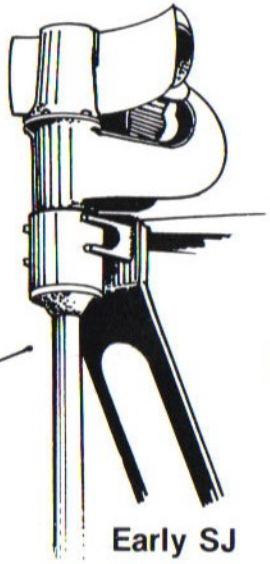
Radars were constantly improved in both reliability and capability as the war progressed. The SD was first improved and then replaced by the SS. Sonars, too, were improved to the point that the late-war FM could guide a sub safely through minefields. Radar turned US submarines into a weapon that could be blinded by neither darkness nor weather and made them many times more deadly than they would otherwise have been.

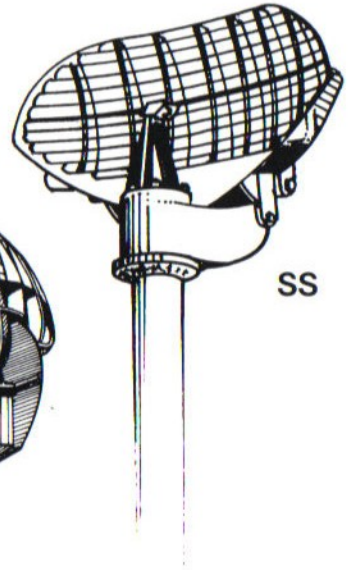


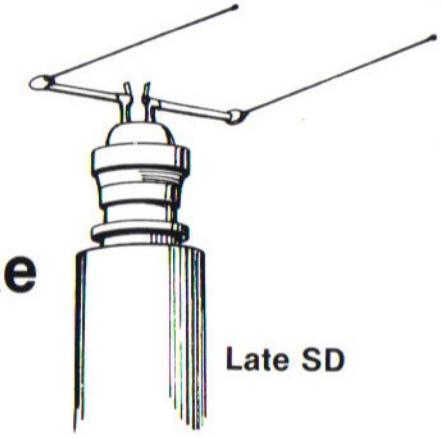
Two views of radar fit. (Above) Searaven **shows a midwar array in this 6 February 1945 view. She carries the later, oval SJ antenna forward with the later, thinner SD antenna barely visible in its retracted position behind the upper lookout station. Also visible are the three stub antennae which were often fitted. The one pointing forward is for the SPR-1, the forward vertical stub is for VHF and the aft for IFF. (Right) Only a few boats received the complete late war fit seen on** Mingo, **17 July 1945. The latest air search radar, the SS, has replaced the SD's bar antenna with the large oval seen here. The smaller oval SJ is forward of the SS. A whip antenna is now used for long-range communications, replacing the rod antenna which had previously doubled as the support for the SD. (US Navy via Bob Cressman)**

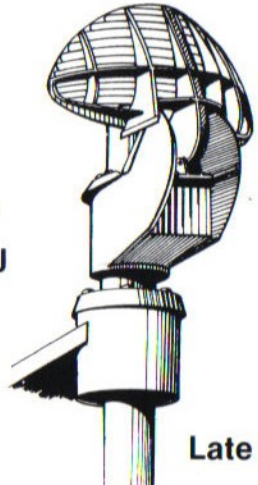
Radar Antennae

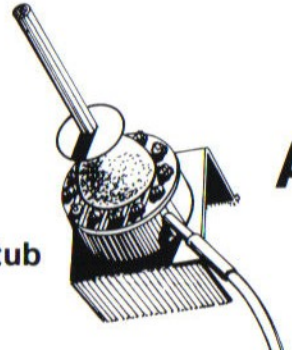


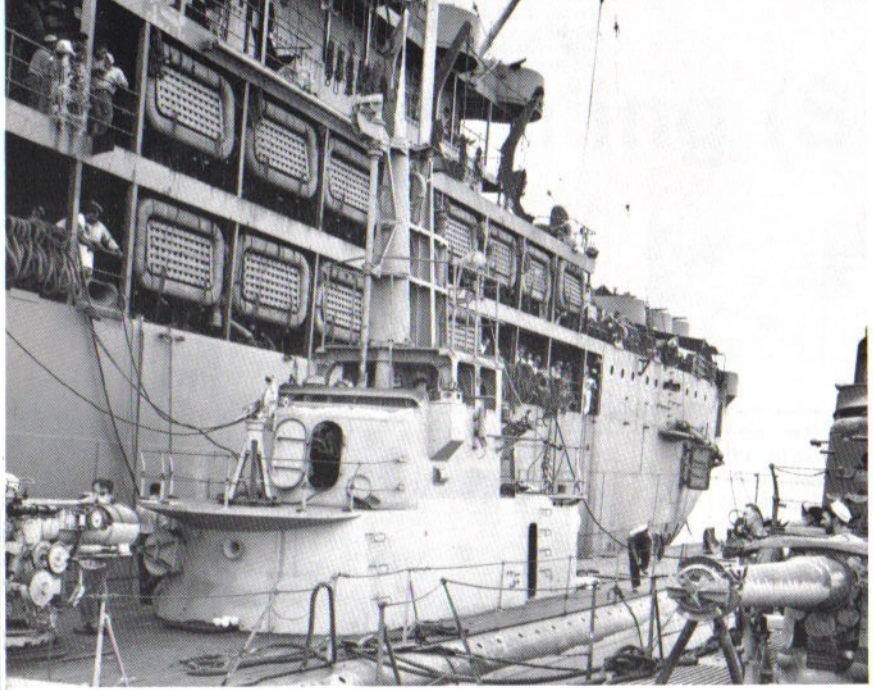


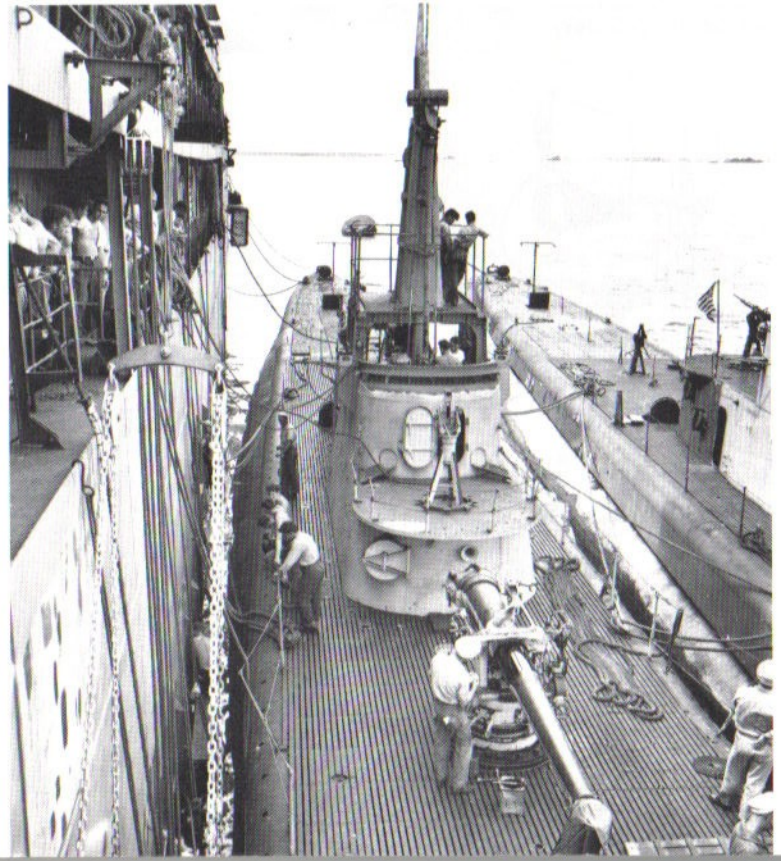


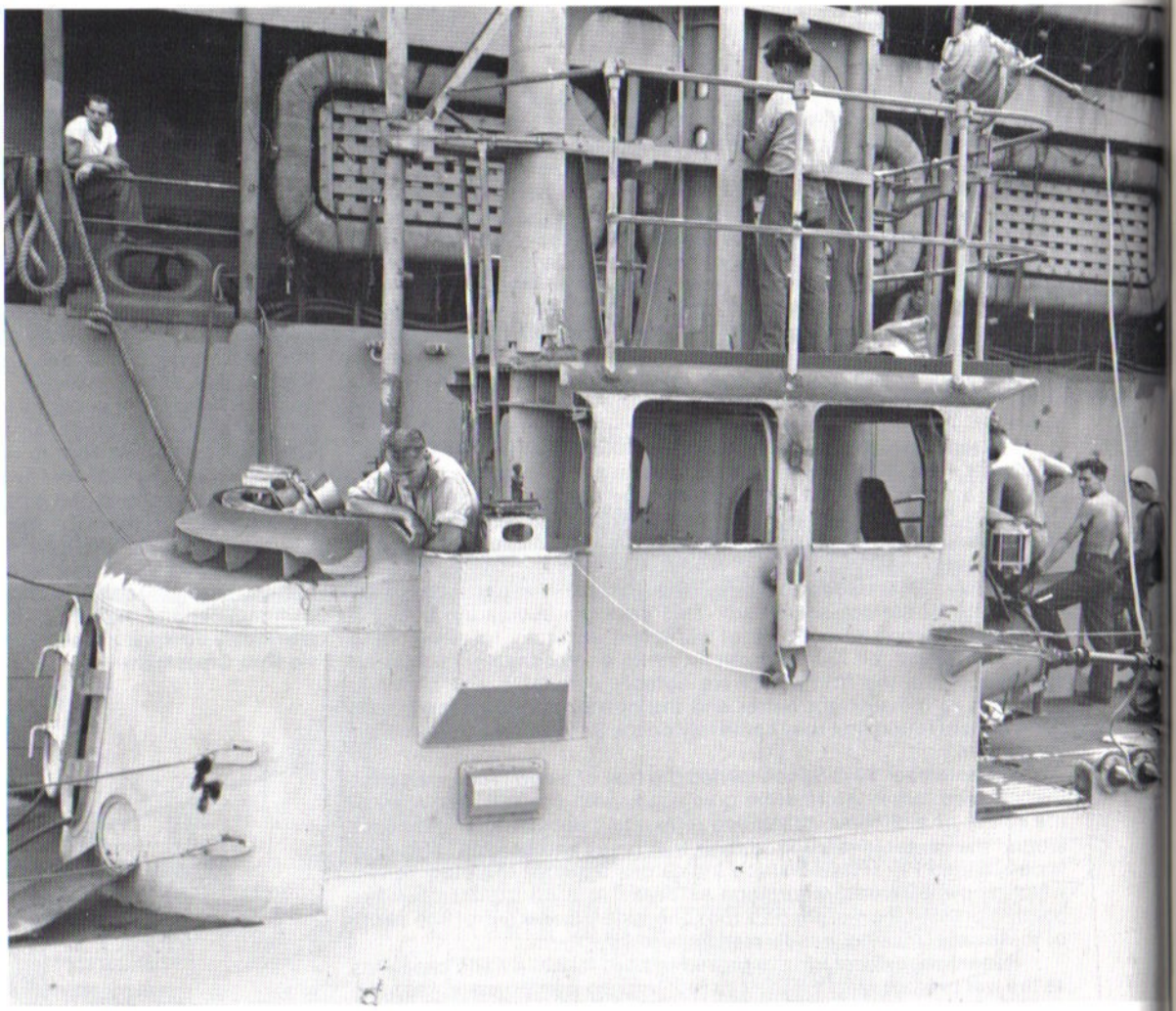




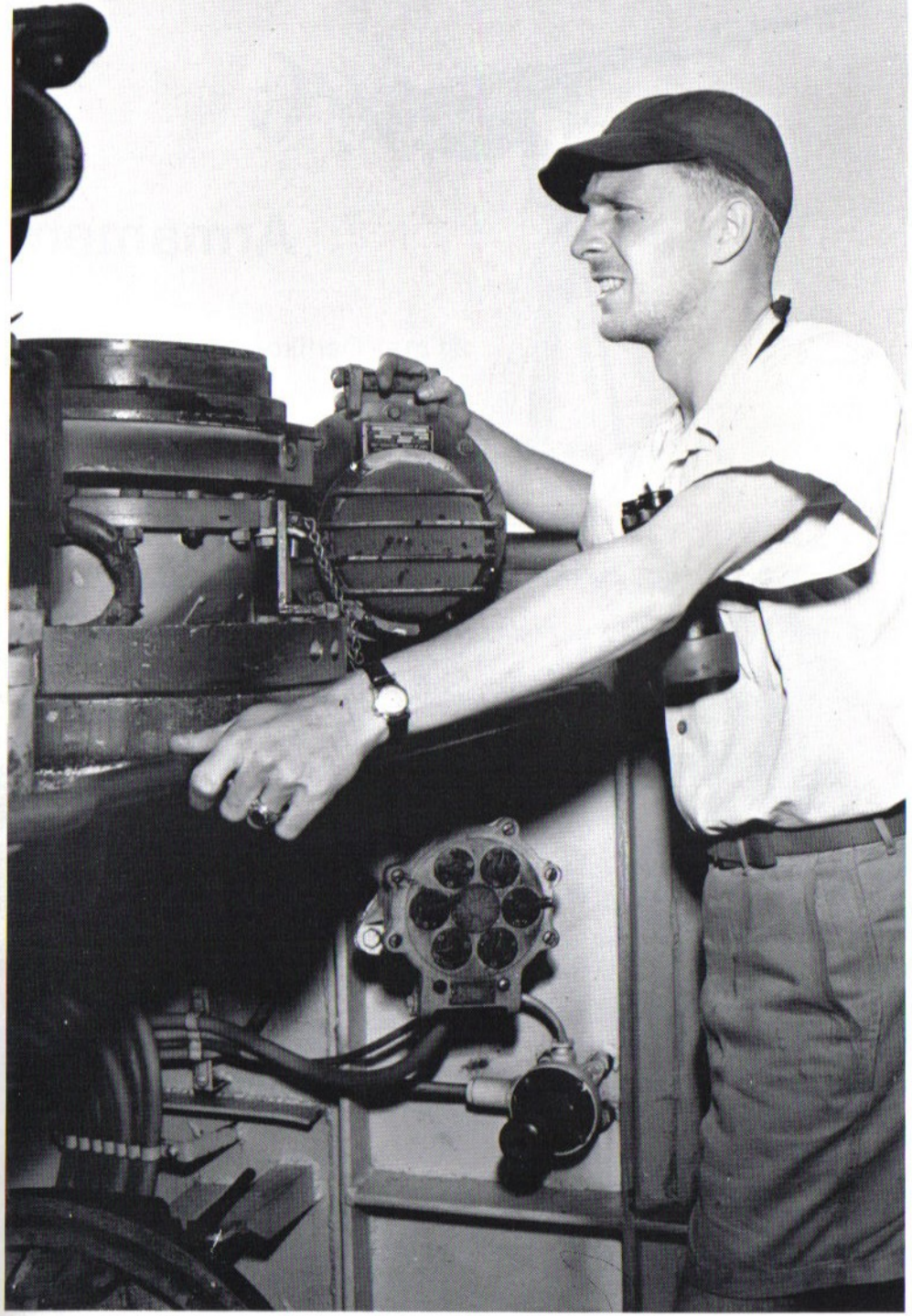




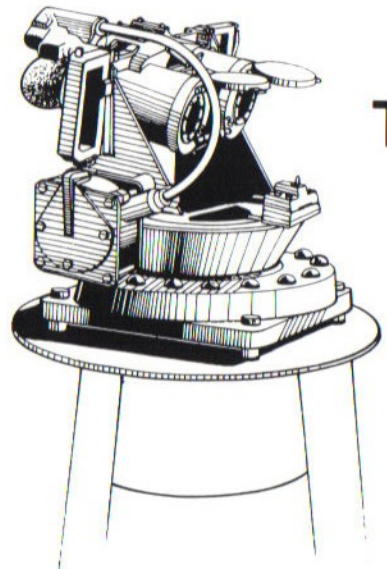




Three excellent photographs show Bashaw's tower structure in great detail as she lies alongside her tender, Brisbane, 9 August 1944. Of interest are the camouflaged periscope tips, a standard practice. Also note the chutes for deck gun ammo forward of the bridge and the TBTs mounted on box sponsons to either side of the bridge rather than fore and aft as was normal. Bashaw is painted in one of the two gray and black camouflage schemes authorized in June 1944. This appears to be the lighter Measure 32/3SS-B. The manual called for the deck to be gloss black to within two feet of the edge, feathered into dull black, dark gray and medium gray into light gray vertical surfaces. On Bashaw this was obviously not done by the book, the black being run up against the light gray without intermediate stages. Note that the upper, vertical half of the fairwater is medium gray, the lower, sloping half is light gray. The unidentified sub next to Bashaw, most visible in the view to the left, is done up in the 'dark gray job', the colors being very artistically feathered though the colors are not in the correct order. Note that the after end of the fairwater has been painted dark gray, part of the instructions for Measure 32/9SS. (National Archives)

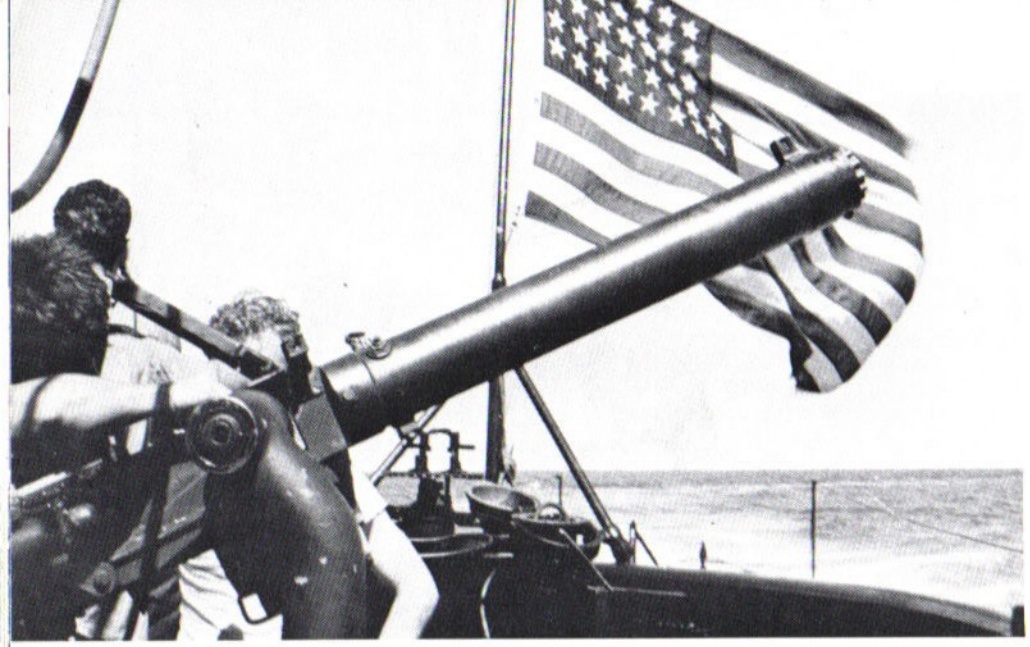


Two views show the items that were usually to be found on the bridge of any US sub. To the left in this photo of Tinosa **can be seen part of the TBT (Target Bearing Transmitter—the surface aiming device), the compass repeater and the combination microphone-loudspeaker 'squawk box'. Below this is a switchbox for communications and the large diving alarm switch. The above view of** Spadefish's **bridge shows the same items in different order. Between the 'squawk box' and TBT is 'Shakey',** Spadefish's **mascot. (National Archives)**

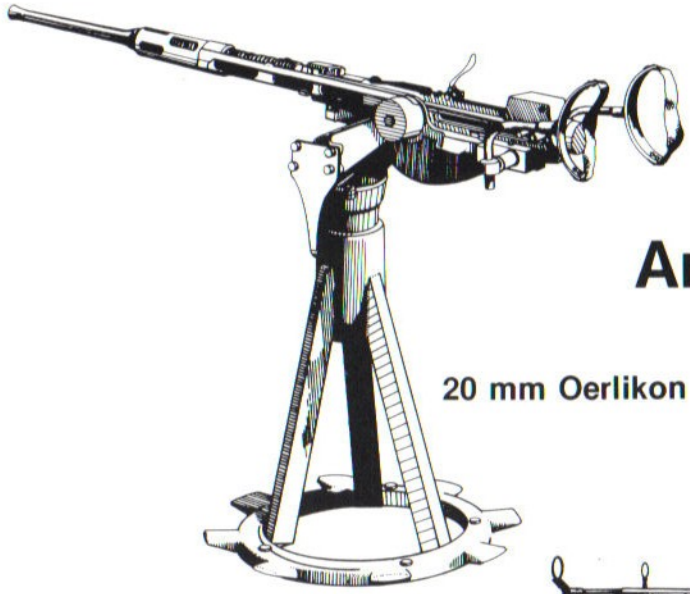


TBT

Armament

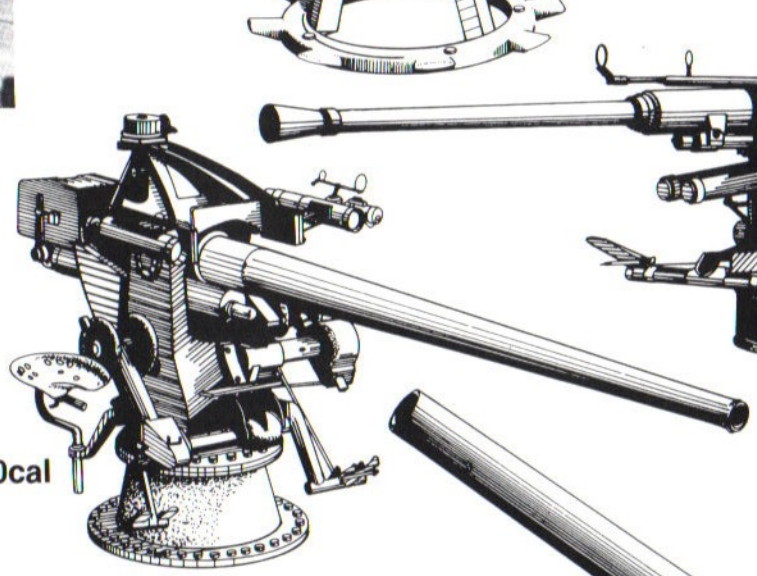


At the beginning of the war most US subs carried only .50cal MGs to supplement their deck gun. The view aft shows a watercooled .50 mounted centrally in the as yet unaltered cigarette deck of Silversides, 1942. As the war progressed 20mm and then 40mm guns replaced the .50s, but the lack of a light rapid-fire weapon was soon felt and many boats, such as the unidentified boat below, had mounts for two air-cooled .50s installed along each deck edge. These would be mounted only for specific use, the .50s being brought in before diving. (National Archives)

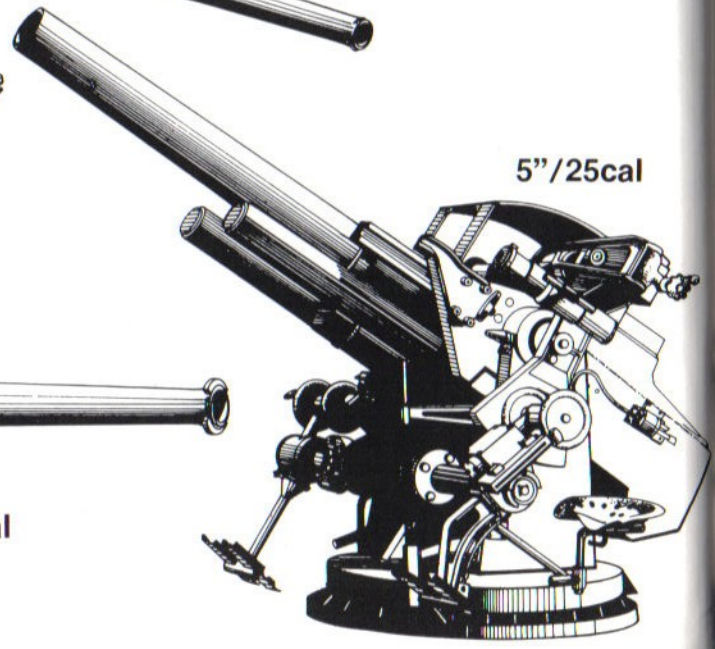


20 mm Oerlikon

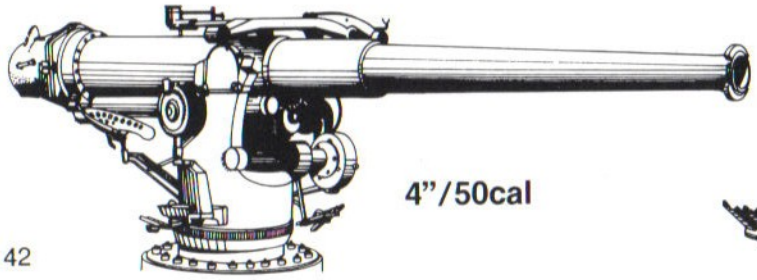
40 mm Bofors



3"/50cal

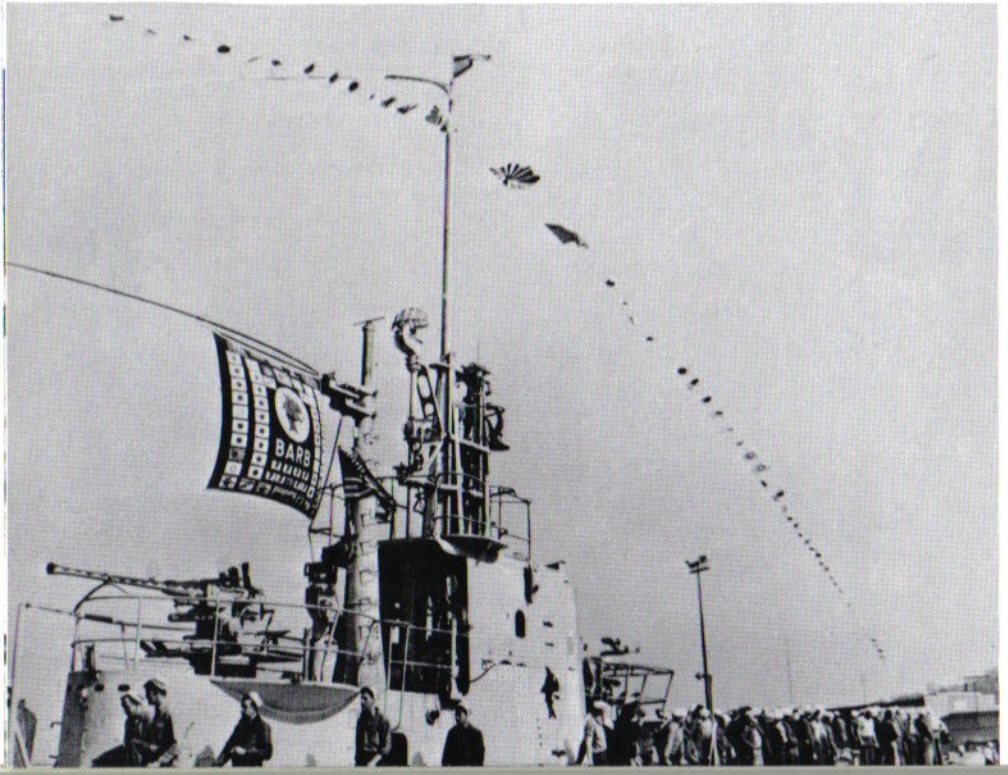


5"/25cal



4"/50cal

Coming into Pearl Harbor at the end of the war Tinosa, **as seen over** Spadefish, **displays a typical 1945 weapons fit. She carries a 5"/25cal gun forward, a 20mm on the forward cigarette deck and a 40mm Bofors aft. Good details of the 5" and 20mm guns and the TBT can be seen on** Spadefish. **(National Archives)**

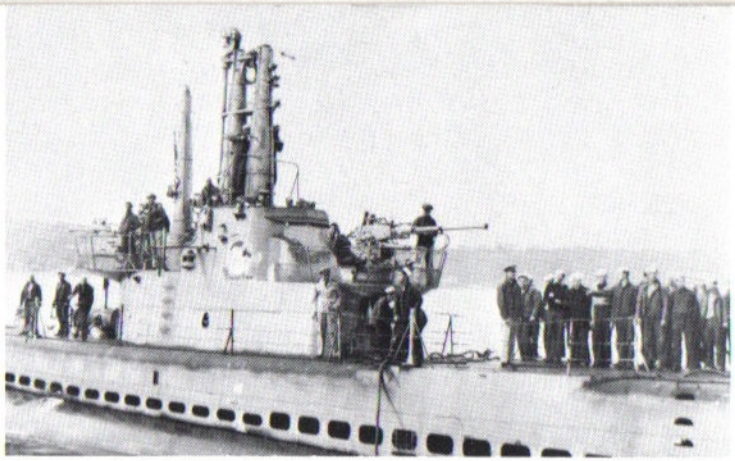


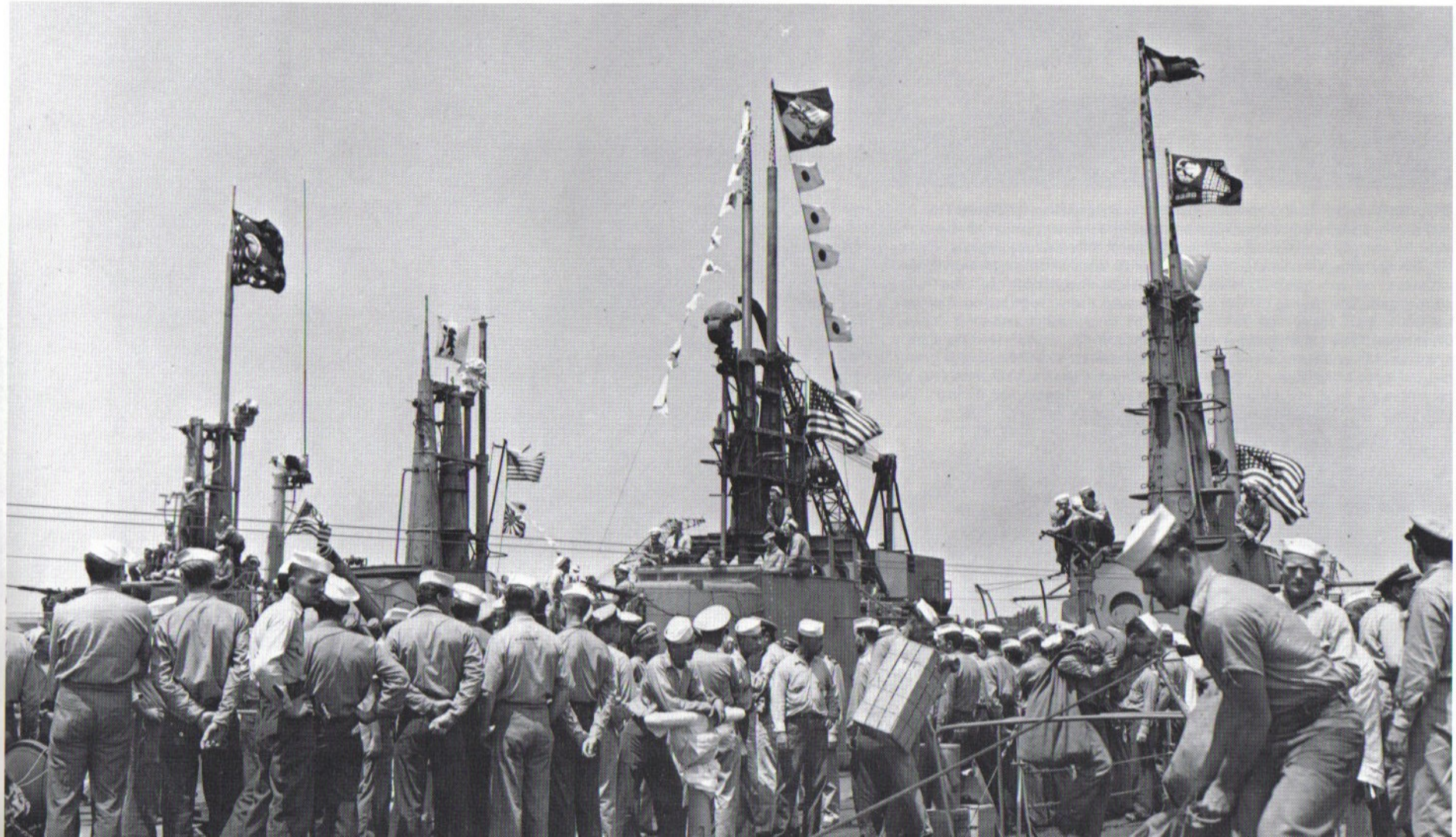
An interesting sequence of three photos show the evolution of Barb's insignia. (Above Left) This 1944 shot shows the crew of Barb with CO Eugene Fluckey in the center around their battle flag. This was probably taken after her ninth patrol in October. The warflag is a fairly crude affair showing claims for two warships, 13 merchantmen and one German ship. On this patrol Barb set a record for the most tonnage sunk by one spread. Five torpedoes sank an 11,000GRT tanker and the escort carrier *Unyo*, totaling 31,000 tons. (Above) Fluckey is seen next to his boat's insignia, now painted on the tower side. Fluckey came to Lockwood's attention when he promised five sinkings before he took Barb out on his first patrol, her eighth. He delivered on the nose. Here he wears a Navy Cross. He also won a Medal of Honor for Barb's eleventh patrol. (Left) Seen immediately postwar, Barb flies all her flags. Note the warflag is now much fancier. There was considerable competition between boats for the flashiest warflag. A red, yellow and blue Presidential Unit Citation flies atop No. 2 scope, (US Navy via SFL)

(Left) Balao, **the first of the 'thick-skinned' boats, returns from her ninth patrol, 29 June 1945, coming back with four prisoners. Her warflag is strung forward. (US Navy via SFL)**

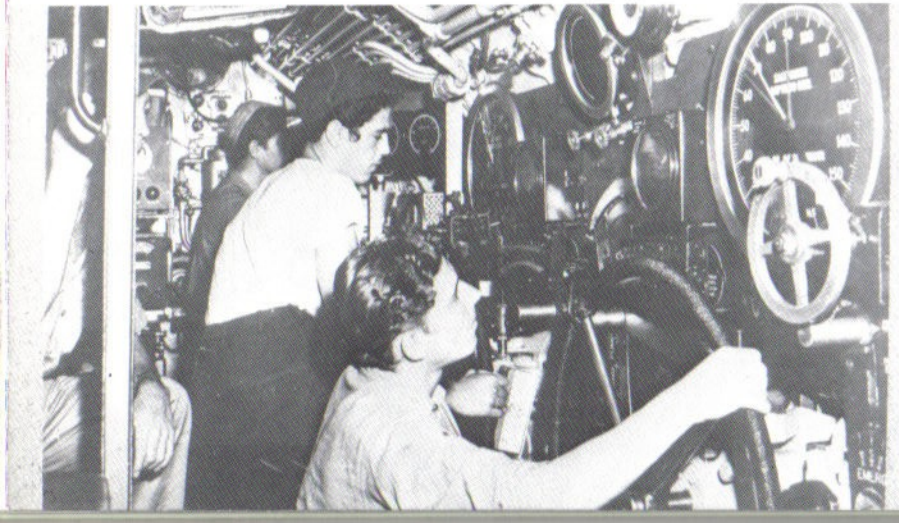
(Right) Tench, **class boat of the third Gato sub-series, pulls into harbor, 1945. She is one of the rare boats to have had her insignia painted on her tower side. (US Navy via SFL)**

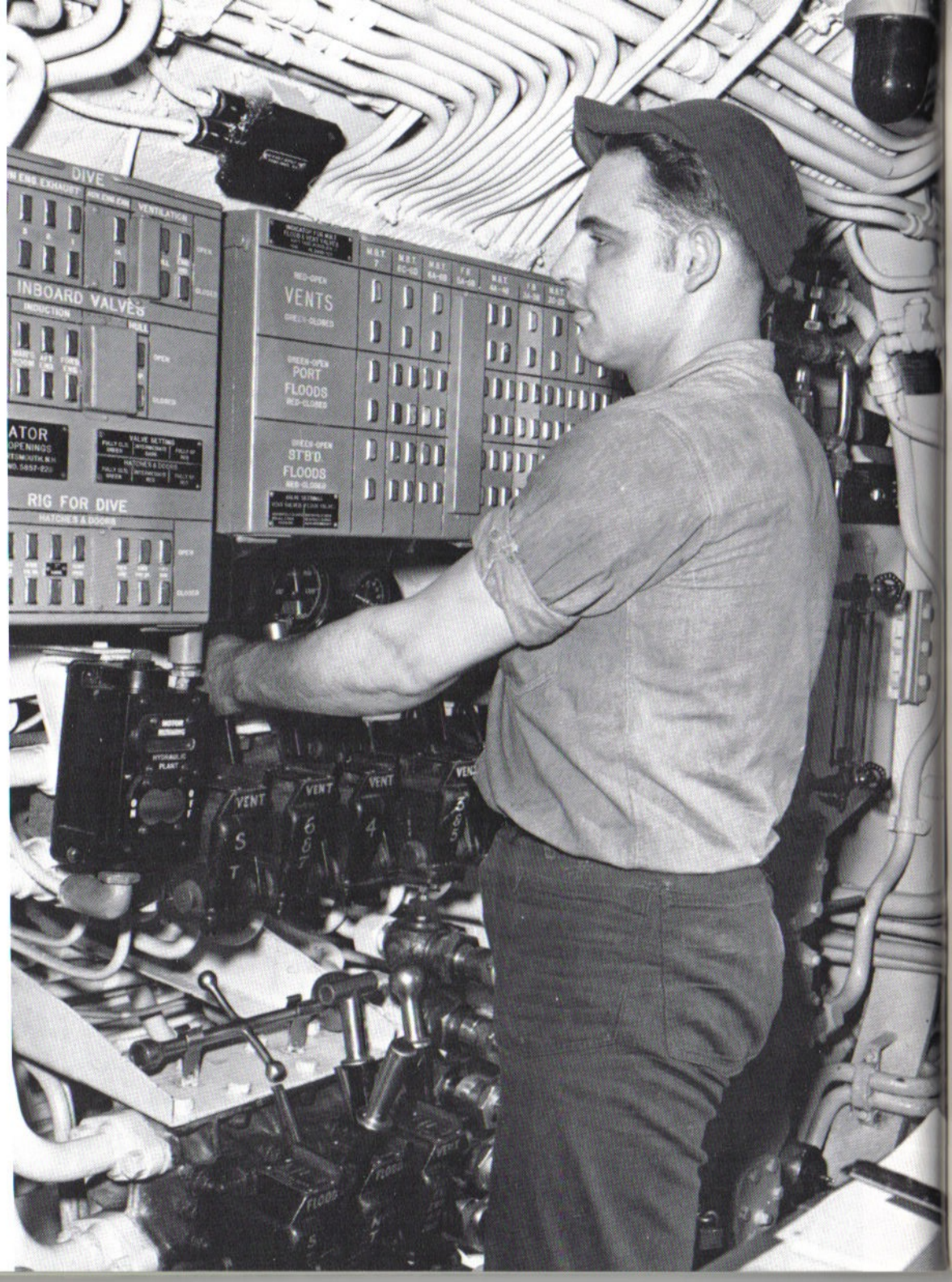
Four subs at Pearl Harbor celebrate the end of the war with flying colors. Each displays its warflag. From the left, they are Flying Fish, Spadefish, Tinosa **and** Bowfin. **(National Archives)**

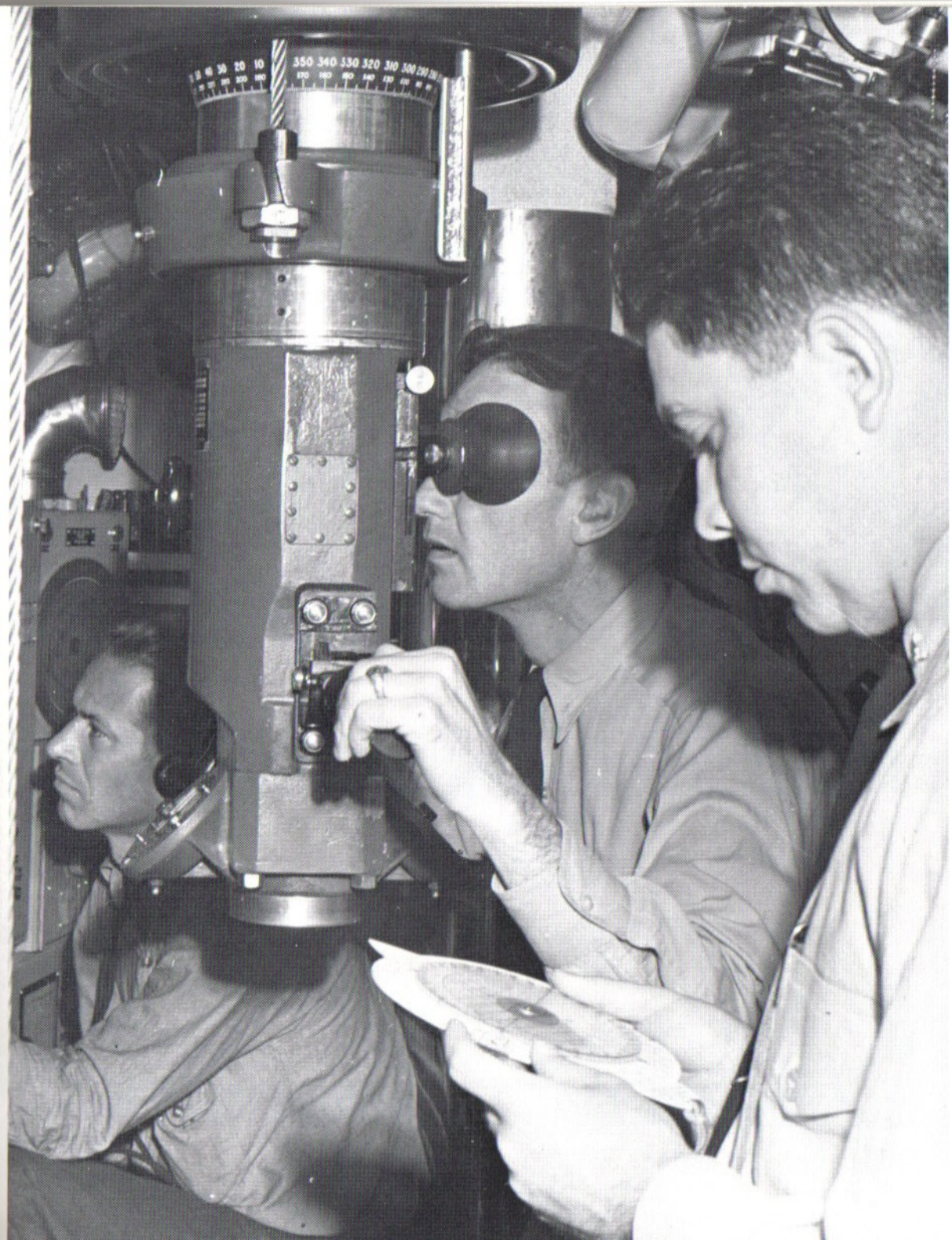


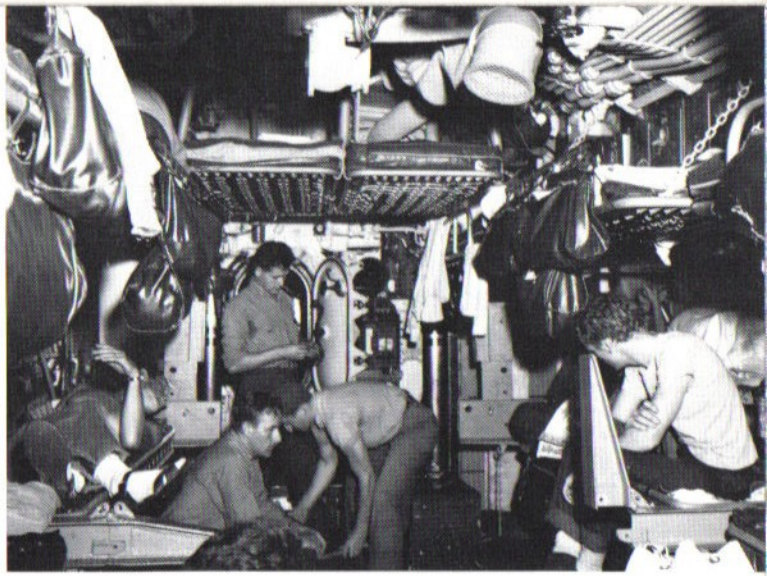


The control room is the nerve center of a submarine. (Above) The navigator works at his chart table which dominates the control room. Behind the chart table are the planesmen's positions. (National Archives) (Below) Spadefish's CO, Germershausen, leans on the ladder to the conning tower overseeing the activities of his planesmen who control the depth of the sub when submerged. The diving officer stands behind them, regulating the balance of the boat. (US Navy via SFL) (Right) A crewman stands in front of the 'Christmas Tree', the boat's condition board that indicates the status of all tanks, valves and hatches. The name originates from the red and green lights that indicate condition. A 'green board' means that all hatches and valves in the pressure hull are closed and the boat is 'rigged for diving'. (National Archives)





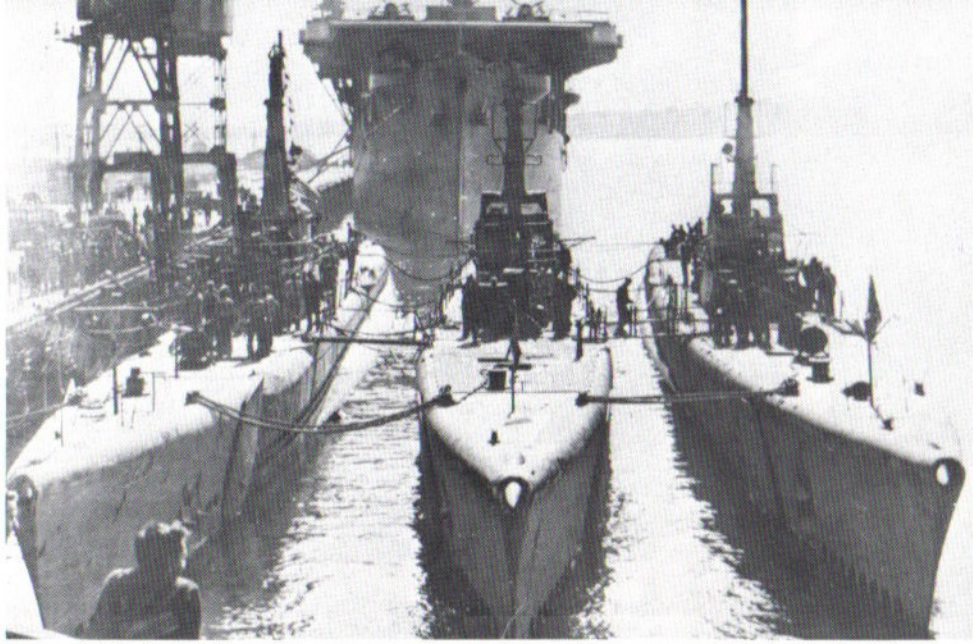




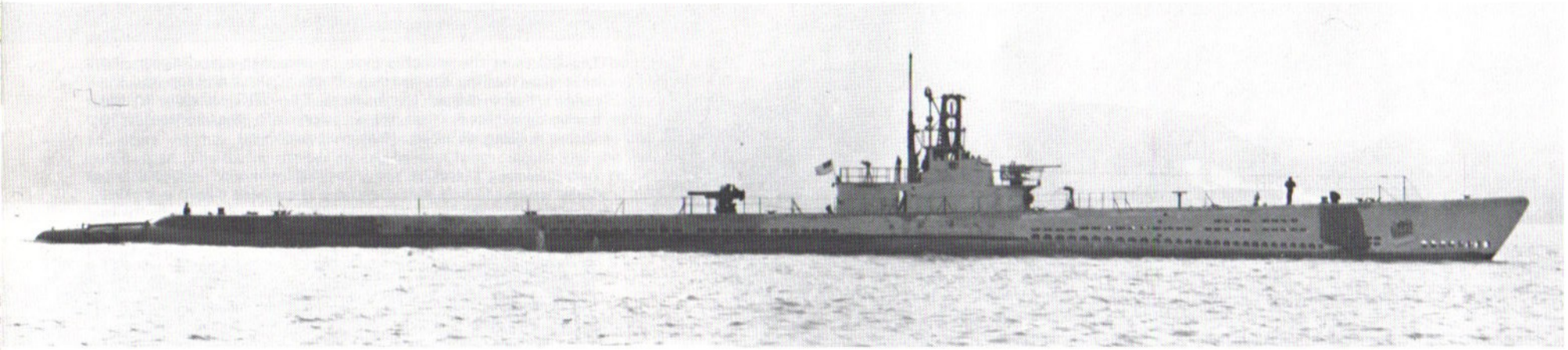
Crew space was built into the boat wherever there was room, in the forward and aft torpedo rooms and in the after battery compartment, seen here. The accommodations were something less than palatial, but would have been the envy of any other nation's submariners. (National Archives)

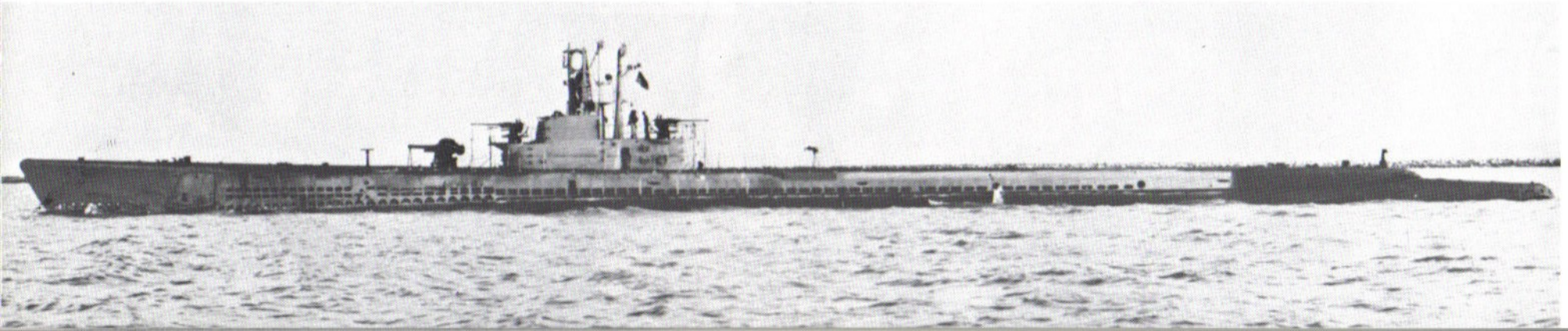
The CO is at the attack scope, a crewman standing on the near side reading the bearing off the scale at the top and the range off the dial at the bottom. The TDC operator in the background feeds that information into the computer to obtain a firing solution. (National Archives)

Two crewmen stand by the throttles in one of Tinosa's two diesel rooms. Each diesel drove a generator which supplied juice to the batteries or the electric drive motors, or both, in any proportion. (National Archives)



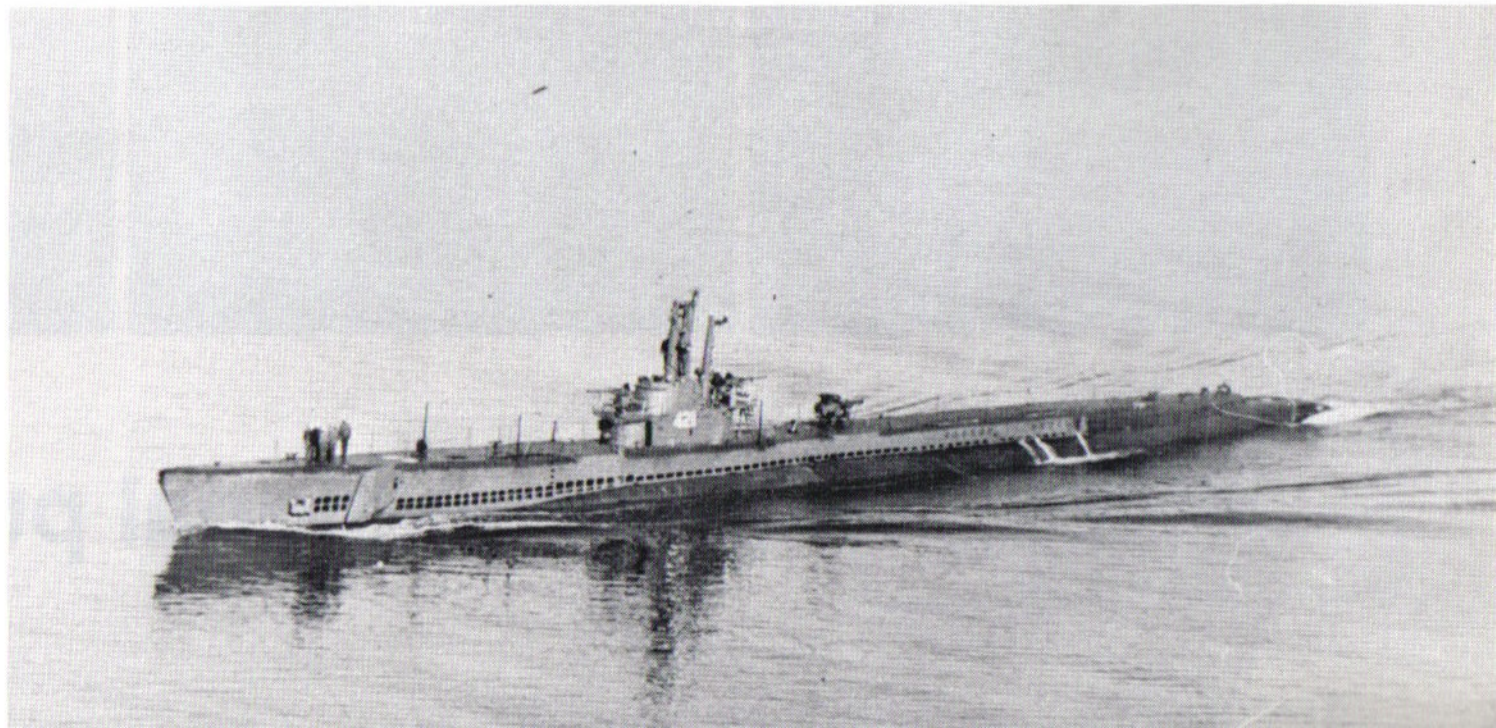
No two US subs, even close sisters, ended the war looking exactly alike. The process of refitting and repair constantly altered the boats, seemingly at the whim of the shipyard. This view at Auckland, 1945, shows, from the left, Cabrilla, Bluefish and Cod. The last two were launched within a month of each other from the same yard but still differ from each other in numerous details, most noticeably the lookout positions. (US Navy via SFL)



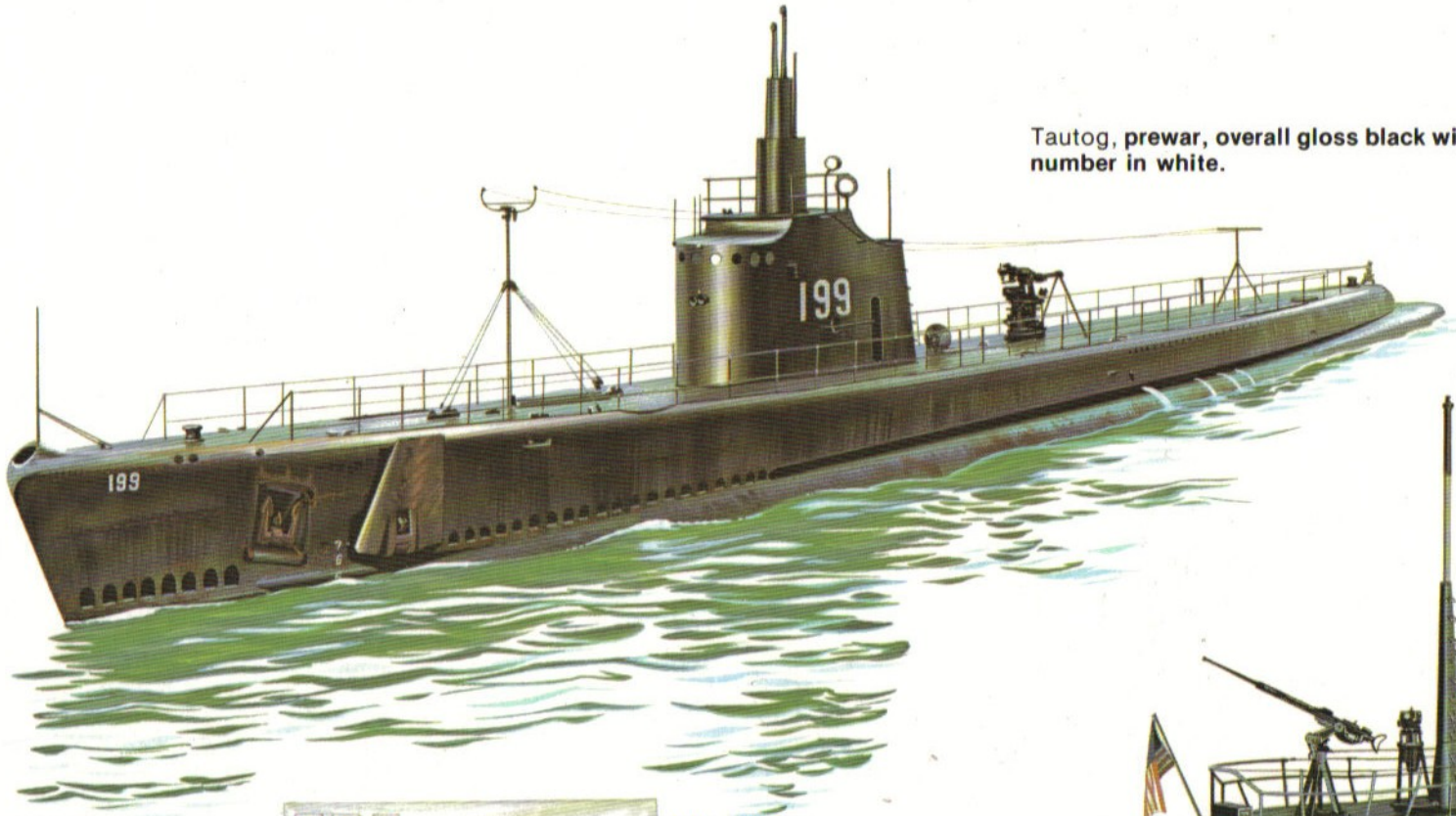


Cero, in the center, and Grouper, at the bottom, show the 1945 appearance of typical Gatos. Cero has had a 5" gun fitted aft and a 40mm Bofors mounted on the forward cigarette deck. She is painted in the 'dark gray job', Measure 32/9SS. From the bow, the colors are medium gray, dark gray, very dark gray and dull black. Grouper, an old campaigner, the veteran of 11 patrols, has had 40mms fitted fore and aft of the bridge as well as the late war radar fit, SS and SJ. (National Archives)

Scabbardfish is a typical late-construction Gato. She was built with her fairwater cut away aft under the cigarette deck, a feature that was added to some earlier boats during refit. As she prepares to leave on her first patrol, 30 May 1944, she still carries a Measure 9 camouflage scheme. (National Archives)

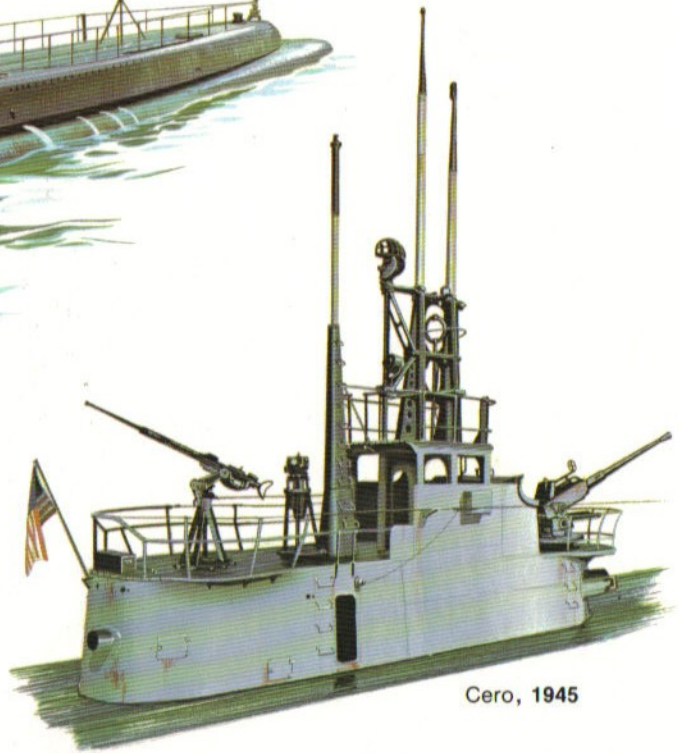


One of only 11 Tench boats to see action, Trutta is seen here after the war. The only noticeable difference in the appearance of US subs in the immediate post war period was the re-emergence of hull numbers painted on the tower side. Trutta came into action in time to make two war patrols, without any sinkings. By this time targets had become so scarce that this lack of success is not surprising. Pickings were so slim that on her second patrol Trutta was used to shell an island in the Tsushima Straits to cover the breakout of eight subs operating in the Sea of Japan. If anything, she was the victim of the very success of the submarine offensive. (US Navy via SFL)



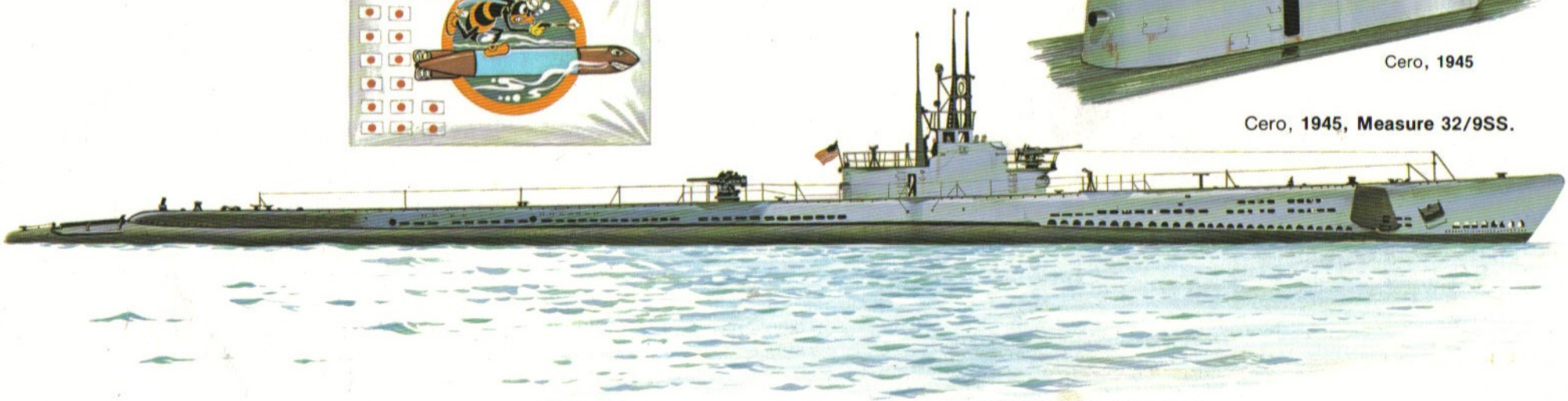
Tautog, **prewar, overall gloss black with hull number in white.**

Balao, **1945**



Cero, **1945**

Cero, **1945, Measure 32/9SS.**



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